THE

ELECTRICAL REVIEW.

VOL. LIX. DECEMBER 28, 1906. No. 1,518.

ELECTRICAL REVIEW.

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THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

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OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGREKAY, LONDON." Code, A B C.
Telephone No. 933 Holborn; 4425 Central.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

(J. A. BERLY'S).

1907 Edition

TO APPEAR IN JANUARY.

Advertisements, new names and corrections to existing entries should be sent in at once.

CABLES AND THE COLONIES.

THE address delivered by Sir Sandford Fleming before the "Eighty Club" on July 20th, 1906, on a proposal to establish a great Imperial Intelligence Union to promote the consolidation of the British Empire, has just been published in the form of a pamphlet, together with a summary of Canadian views, and replies to criticisms. Unfortunately, the pamphlet does not appear to contain a complete account of the discussion; its value as a contribution to the problem of Imperial development therefore loses in breadth of view. Nevertheless, the weight of opinion of Sir Sandford Fleming has to be acknowledged; and his pamphlet serves to awaken interest in a project whose intention, wholly directed towards the improvement of Imperial relationships, is profitable for study by all British peoples.

We gather that the proposal is to organise an Intelligence Service, having at command a system of cables sufficiently comprehensive in their scheme of routes to ensure adequate communication between the Imperial coasts, with a view to the general advancement of all that makes for the healthy development of British interests,—the primary principle being the free exchange of Imperial news. This implies the creation of an Imperial Intelligence Department, and the suggestion is that there should be a Central Board in London, agencies in each self-governing community, and arrangements at all of these *foci*, for the selection, transmission, or reception of such news as is desirable and available for simultaneous publication in the journals of "all the great cities of the Empire," free of charge. On the other side of the equation, it is estimated that the cost would be £5,000,000, to be divided in equitable proportions between the United Kingdom, Canada, New Zealand, Australia, South Africa, and the West Indies, forming "but a light burden on each." It is contemplated that a few hours in each day would suffice for the free transmission of Intelligence Department news, and that all working expenses would be fully met by earnings derived during the remaining hours from "paying" traffic.

In matters as potently affected by sentiment as is the Imperial idea, it is difficult to preserve that strictly judicial attitude of mind which is necessary to ensure that efforts are wisely directed. Every Imperialist statesman is aware of this; he knows that he has only to appeal to "the great heart of the Empire" upon the glories of the bond of union, and he will stir his British hearers into a chorus of cheers. Long and increasingly may it be so; but the cheers must be tempered with judgment. This bond of Imperial union is the finest sentiment we possess; it will be kept so only by bringing to bear upon it the finest judgment the Empire can command. The condition as to whether the Empire is to consist of ill-organised and distinct mobs, or of concourses of well-fed, well-clothed, well-protected, and well-informed citizens, depends in no small degree upon the

manner in which Sir Sandford Fleming's ideals are materialised. It must be recognised that the time is appropriate for revision of the means available for news transference; but it seems wise to accept with reserve the suggestion that its transmission should, to the extent indicated by Sir Sandford Fleming, become an Imperial undertaking.

We gather from the pamphlet that there is a consensus of opinion as to the benefits that would follow from intercourse more free and more full between the respective oversea communities. It is admitted that advantages would undoubtedly follow from the systematic distribution of news relating to matters Imperial. Further, there is clearly a wide-spread feeling—a feeling with which we have always associated ourselves—that the submarine cable system of the British Empire is in many directions inadequate to the demands of peace, and to the prospective demands of war. With all this we cordially agree. But the point upon which we are unconvinced is that the proposed extensions of the cable system should be combined with a news system managed by the State. It is quite possible that such a proposal is susceptible of argument, but the pamphlet before us does not seem to embody sufficient evidence to establish a case for such a scheme. Our cardinal difficulty is that where there is State aid there must be State control, and we hesitate to accept the position that the State should control the distribution of news. The limit of such a system would be State newspapers, with all the possibilities of party strife, and inter-colonial differences, accentuated by accusations of lack of fairness on the part of the Imperial distributors and receivers. Either this, or the dissemination of colourless details, leading to complainings of another kind against the Imperial Autolycus. Moreover, if the State became in any respect associated with the selection and transmission of news—as news—it would inevitably find itself from time to time in difficulties regarding accusations of disclosures of Press messages, and possibly of State secrets. It would appear to be quite practicable, and it might, in many cases, be highly desirable for the State to lend aid towards the extension of the cable system for the transmission of *words*, but under existing circumstances the State had perhaps better leave *news* alone, lest news becomes history before its time.

It is established, so far as this country is concerned, that the State *distribution* of Press matter is an enormous benefit to the community and an improvement upon the system of distribution of Press matter by such private telegraph companies as preceded the British Postal Telegraph service. This exemplifies our contention that the State distribution of *words*, as distinct from *news*, is desirable, and that it might, with great advantage, be extended to cable communication with the Colonies. In this country State telegraphs brought down the price of telegraphic messages, and, thanks to Scudamore, led the way to the wonderful facilities that characterise the existing system. Why, then, should not the same method of development reduce the price and facilitate the delivery of Colonial and all inter-British telegrams?

The lesson which the *Times* is teaching in the matter of books requires to be extended to the matter of the dissemination of intelligence generally. Given that, according to our system, comparatively few can enjoy the benefit, the price being opposed to them; and given that, according to a second system, the benefit is conferred upon a vastly greater number; then, if the second system can be shown to be within the range of practicability, and the profit fair to the seller, the public interest should decide the issue in favour of the reduction. This is scarcely the place perhaps to discuss the strategical advantages of submarine cables in time of war; we may, however, point out that they constitute a factor scarcely second in importance to the Navy itself in the *prevention* of war, and they will prove to be of vast consequence in the critical hour or two before war is declared. The sum of £5,000,000 necessary to provide the links of Empire asked for in this proposal of Sir Sandford Fleming's is a vast sum if doled out in sovereigns; but reckoned in battleships it is comparatively insignificant. And who shall say that a completed Imperial service of submarine cables will not, at the moment of war, or just preceding war, be of value equivalent to, say, three battleships. A further factor is that the expectation of life of a cable is about 30 years, while the expectation of life of a battleship is scarcely more than a third of that period. It is true that a cable can be cut; it is also true that a *Montague* can be lost.

A Prophecy Fulfilled.

A remarkable prediction has been fulfilled in relation to electrical schemes in South Africa by the proposed absorption of the undertaking of the Rand Central Electric Works, Ltd., by the Victoria Falls Power Co. It has been mentioned in German circles on two or three occasions during the past few months that, while the General Electricity Co. has identified itself with the scheme having for its ultimate object the utilisation of the Victoria Falls of the Zambesi, the group associated with the Siemens & Halske Co. is interested in the enterprise of the Rand Central Electric Works, which were originally constructed by that company. The prediction has been that, although the two German firms were thus apparently brought into competition with each other in this particular area, they would eventually reconcile their opposing interests in this respect and begin to co-operate with each other. The fact of the transfer of the Rand Works to the Victoria Falls Power Co. shows that the prophecy has been fulfilled in some way or other. It is quite immaterial whether the realisation of the prediction has been, or has not been, brought about over the heads of the two firms and their associated companies. The important point is that the consolidation of competitive interests is being carried into effect, and in this sense peace has been established. It is noteworthy that the last occasion upon which co-operation instead of rivalry was foreshadowed in Berlin was on December 12th, and a few days later, as previously stated, the projected absorption of the Rand Works by the Victoria Falls Power Co. was announced by the latter.

Trade News from Abroad.

It is satisfactory to learn that some further improvement, however small, is to be made in connection with our Consular reports and in the placing of foreign trade information at the disposal of those concerned with it. The Board of Trade Commercial Intelligence Department displays nowadays a creditable activity in making known, through the Press, such information as comes into its possession. In future, according to arrangements which were announced by Mr. Lloyd-George last week, the Board of Trade will co-operate with the Foreign Office from the beginning of the New Year in the editing of the annual Consular reports, and every possible effort will be made to expedite their issue. The Foreign Office has instructed the Consular officers to make their reports promptly—using the telegraph when necessary—concerning matters of immediate commercial importance. When such news arrives on this side it will "either be communicated direct to those whose interests are concerned," or utilised in the official weekly publication of the Board of Trade. With the increased attention now being paid to foreign trade by English electrical firms, there will be a general feeling of thankfulness for whatever small mercies are vouchsafed in the form of better circulation of information which may assist us to add to the volume of *profitable* electrical business for English factories.

EXPERIMENTS ON THE MERCURY ARC.

The *Revue d'Electricité* some time ago published an article by R. Küch and T. Retchinski, demonstrating a number of new features and effects obtained with mercury vapour lamps. By means of operating the arc in vessels of quartz in the place of glass, these investigators were able not only to work the arc under considerable gaseous pressures, but in addition to apply greatly augmented potential differences between the terminals of the lamp, as compared with what is possible in other types of mercury vapour lamp.

In ordinary glass vessels, it is not possible to use a greater pressure than 1 volt per centimetre length of the arc, whereas in the quartz vessels employed, it was possible to raise the pressure to 30 volts and more. As a result the conditions of temperature and vapour pressure differed from any previously obtained. Special cathode and anode terminals were employed, and the terminal bulbs in which they were placed were of different dimensions so as approximately to correspond to the different temperatures developed in each. The arrangements made permitted the lamps to operate for long periods without interruption. The more rapid the cooling of the terminals, the greater may be the pressure applied, and to enable lamps of small dimensions to be worked at a considerable voltage, the terminal receptacles were cooled by metal envelopes. Provided the walls of the vessels are sufficiently solid to resist an internal pressure of four atmospheres, it is possible to apply a range of from 25 to 400 volts; in general, however, the maximum voltage was applied 220, a resistance of 50 ohms being included

TABLE I.

Volts.	Amperes.	Pressure in cm. of mercury.	Volts.	Amperes.	Pressure in cm. of mercury.
36	2·78	0·2	132	4·50	42·6
40	3·15	0·6	154	4·80	58·7
60	4·10	3·8	181	4·75	82·7
67	4·20	9·0	201	4·60	104·0
87	4·30	14·0	220	4·45	121·0
96	4·50	19·1	249	4·40	150·0
114	4·50	29·5			

in the circuit. When worked at a low voltage the arc fills the whole section of the tube, but as the voltage is increased the arc narrows down, until at length it becomes a thread of 5 mm. diameter. Table I gives the pressure of mercury vapour in the lamp at different electrical pressures, the former being measured by a manometer 2 metres long. "With an electrical power of 600 to 700 watts, for which the vapour pressure is only about 80 cm., the central portion of the tube is of a dull red. It results from this, that one has in this portion of the lamp to deal with non-saturated vapour, for the mean temperature of the arc must necessarily be higher than that of the walls."

TABLE II.

Volts.	Amperes.	Watts.	Hefner units.	Watts per Hefner unit.
27	1·90	51·3	66·0	0·778
30	2·20	66·4	76·7	0·866
34	2·60	88·3	94·6	0·934
56	3·20	179	224	0·799
96·5	3·52	340	860	0·395
121	3·67	444	1,560	0·284
175	3·80	665	3,180	0·209
235	3·90	917	5,040	0·182
304	3·85	1,170	7,130	0·165
48	4·31	207	222	0·934
73	4·84	353	676	0·523
114	4·82	549	1,900	0·288
206	4·60	946	5,140	0·184
251	4·45	1,115	6,460	0·173

Determinations have been made both of the illuminating intensity and of the spectro-photometric phenomena of the light emitted by these lamps. As with all other mercury arc lamps worked at low electrical pressure, the power consumption curve at first rises, and after a maximum has been reached, which occurs with a consumption of about 100 watts, it falls rapidly until it is nearly parallel to the axis of the abscissæ, but still without losing its falling tendency. This may be seen by Table II. It is claimed that the greatest efficiency of luminous rays yet reached has been obtained, viz., ·185 watt per Hefner candle, the lamp being placed in an upright position. With lamps of larger dimensions than those used, it is surmised that a still higher point of efficiency might be attained.

It is particularly interesting to note that the consumption curve reaches a maximum. This is, no doubt, owing to the fact that the light due to luminescence, which diminishes in efficiency, is overtaken by that due to the increasing temperature. "The results of our determinations confirm the bolometric determinations made by Angström on Geissler tubes. This physicist has been led to the hypothesis that the radiation of gas at the moment of an electric discharge is composed of two parts, the one of a regular, the other of an irregular nature; when the electric pressure diminishes the former diminishes, and the latter augments, the more so as the movements across the gaseous mass become freer. He has besides enunciated the theory that if the gaseous pressure is augmented the conditions of vaporisation vary considerably, the abnormal radiation is more easily transformed into normal and the radiation becomes richer in ultra-red rays."

The ultra-violet radiation produced by these lamps at an increasing voltage was also studied. This was effected by an ingenious apparatus designed to utilise the property which these rays possess of discharging negatively charged bodies. The general curve obtained from an investigation of these rays is very similar to that demonstrating the luminous rays, viz., that they increase in intensity up to the highest electrical pressure applied; but it is interesting to note that as regards the power consumption curve the maximum is attained at another and higher point as compared with that indicating the luminous consumption curve.

TABLE III.

Volts.	Amperes.	Watts.	Intensity of the ultra-violet radiation.	Watts per unit of ultra-violet radiation.
36	2·03	73·1	28·2	258
39·5	2·50	98·7	30·7	322
46	2·79	128·5	32·1	401
56	2·90	162	36	451
69	2·92	202	46·8	430
79	2·95	233	59·9	389
100	3·03	303	99·0	307
135	3·04	410	214·5	191
172	3·13	538	390	136

Perhaps the most interesting and important results attained by these investigators are those arrived at by their study of the spectrum of the light. They have found that, as the current intensity is increased, the light changes in quality; it loses its green character and becomes more yellow, whilst certain red rays also become manifest. In other words, a light is emitted which approaches much more nearly to white light than that obtained from the Aron and other types of mercury arc lamp, which produce a light sadly deficient in certain colours. The reason for the difference is the development, owing to the increased temperature, of a light giving a continuous spectrum, which light grows in intensity as the current is raised. For tables illustrating the spectroscopic determinations and other particulars, we must refer those specially interested to the original article.

Other investigators have been at work endeavouring to remedy the defects of the light ordinarily emitted by the mercury arc. Thus we learn that MM. F. Gehrcke and O. von Baeyer claim, according to the *Elektrotechnische Zeitschrift*, to have succeeded, by the introduction of zinc and sodium into the mercury electrode, in adding to the light the lacking red and yellow rays, the resulting light being similar to that of the Bremer lamp. By the addition of a little bismuth to the amalgam, ruptures of the quartz tube, which served as the lamp vessel, were avoided, whilst the rays due to the latter metal were too feeble to affect the light injuriously.

SOME PRACTICAL NOTES ON THE COMMERCIAL DEVELOPMENT OF ELECTRICITY SUPPLY UNDERTAKINGS.

By R. BORLASE MATTHEWS, Wh. Ex., A.M.I.C.E.

Tabulation of Mechanical Aids to New Business Getting.*

The various mechanical aids to new business getting that have already been mentioned, may be tabulated together with the details of their operation as below :—

Main Card Index.

Arrangement : (*a*) In alphabetical order of streets.

(*b*) Streets indicated by guide cards with projections at the left-hand side.

(*c*) Intersection of cross streets on a street, indicated by guide card with projections at the right-hand side.

(*d*) North and south or east and west sides of streets indicated by another set of guide cards with projections a little way from one end.

(*e*) Where streets are long, more guide cards should be used to indicate the house numbers.

(*f*) Streets, or parts thereof, through which service wires are laid can be indicated by guide cards, coloured on one side, the coloured sides so faced or turned, that the cards included between any pair of these faces bear the addresses of buildings in reach of present service mains.

Containing : (1.) In addition to occupant's name and address, the classification letters S, R, P, and if a customer his rotation number also.

(2.) Name of owner of building.

(3.) Date of verification of the information.

Note : Cards must never be removed from main card index except temporarily for correction.

File Card Index.

Arrangement : In alphabetical order of the occupants' names.

Containing : In addition to the name and address, the number of the folder in the file containing all correspondence, data and other records relating to that particular occupant.

Note : (*a*) Even if there is no correspondence, &c., to file, a card should be made out (without a folder number) for every address in the city. The index can then be used to locate a man whose name only is known.

(*b*) Cards must never be removed from this index except temporarily for correction.

Vertical or other Files.

Arrangement : In numerical order of folder. The folder number for customers should be the same as the rotation number. A separate series of numbers should be utilised for other than customers, the number being changed on the folder and file card index for the rotation number, when the person concerned becomes a customer.

Containing : All correspondence, agreements, estimates, &c., also all technical data and general information collected by canvassers.

Note : When any information is required, the whole folder should be taken out. On no account should anything be removed from a folder once it has been placed there ; in this way much confusion can be avoided.

Address Plates of Addressing Machine.

Arrangement : In three main sections. (S) Shops and business premises ; (R) residences ; (P) places where power is used ; each section being divided into six sub-sections.

Mark.	Indicates that addressee
1	Is not at present interested
2	Partially interested in light, heat and power
2 (L)	Partially interested in light
2 (H)	Partially interested in heat
2 (P)	Partially interested in power

Customers are indicated by their rotation number and respective section letter S, R or P. Each section should, if possible, be contained in a separate case to obviate any danger of mixing.

Section Card Index.

Arrangement : (*a*) The same as that of the address plates of the addressing machine.

(*b*) Clips or markers, bearing a number corresponding to the day of the month, can be attached to the cards referring to any occupants, whom it would be wise to look up on that particular date, or with whom an appointment has been made for a future date. Thus the index will serve as a constant reminder of these dates, and for that purpose should be examined every day.

Containing : (1.) Address, as on address plate, with section and sub-section mark.

(2.) A dated record of the numbers of all form and circular letters sent out, also booklets and other advertising matter, and dates of personal call.

Maps of Territory.

Arrangement : Location of high-tension, service and power lines marked in different colours.

Information File.

Concerns any electrically operated apparatus ; data kept in classified folders.

Information File Card Index.

Subjects in alphabetical order.

General Instruction Book.

A book of the loose leaf form, with contents classified, containing notes on the general schedule decided upon, and copies of standing instructions relating thereto. Duplicate copies of this book should be maintained—one for the use of employés and the other for the manager's reference.

Only those who have applied the labour-saving business aid, known as the "card system," to the commercial department of a central station, can realise how unwieldy and useless it is apt to become, unless carefully thought out. The basis of the scheme suggested here is that the main index is arranged in alphabetical order of the streets ; this is done on the assumption that the buildings are the permanent features, and the tenants liable to change. This list covers the main requirements. For circularising and other special purposes, it is necessary to distinguish between shops, residences and factories, hence a corresponding classification and any needful sub-classifications are made of the address plates of the addressing machine, each set being still kept in alphabetical order of the streets. If an addressing machine is not employed, the main card index will serve as it is for copying the addresses from, the classification mark decided upon being put very clearly on each card.

Someone has doctored up an old saying, and made it read thus : "A little system is a dangerous thing." This is also true of too much system. In organising a new business or commercial sales department, the central station manager will do well not to forget that it is possible to become swamped with system if the thing is carried to extremes.

A good system should be devised for the business, and not the business turned upside down to fit any one particular system—no matter how highly recommended.

Cost of Operating a New Business Department.

The next point to be considered is the question of the total expenditure needed for the maintenance of an aggressive new business department. It may be mentioned as a guide in this matter that some of those central stations that have proved such a department to be a success, commenced by laying aside from 2 to 3 per cent. of their gross incomes for its maintenance ; as the business increased, this percentage, though not the total amount, was reduced somewhat.

About two-thirds of this percentage is apportioned to personal canvassing and the balance to general advertising expenses. Such an expenditure has proved to be a very profitable investment, as the increase in sales of current has often exceeded the cost of getting it nearly ten-fold.

* Previous articles of this series appeared on pages 650-1, 656-7, 728-9, 808-9, 849-850, 888-9, 929-30, 971-3, and 979-80 of the current volume.

The Gist of the Main Scheme of Operation.

The main scheme of operation as explained earlier may be summed up as follows :—

Canvass first, all the occupants of buildings within reach of the present distribution system. Meanwhile advertise by monthly magazine, by circular matter and in newspapers; any inquiries that result from this or other sources, for service in a direction not at the time reached by the mains, should be promptly attended to, and if closed followed up by a canvass of the route that is proposed to follow with the new service, thus ensuring a return on the capital outlay at an earlier date than is usually the case.

With a well organised new business or commercial sales department, it may be counted a good policy to arrange to supply current to all parts of a town. The householder, resident on the outskirts of the town, who wants electric light is not altogether hailed with delight by the average central station manager, for the interest on the distribution investment required amounts to more than the current bills; but this individual disappears if a very large percentage of the houses adopt electric light, as no building can then be very far from the distributing line. Having decided on a progressive policy, every effort must be used to remove the impression usually acquired by the average inhabitant that it is no use wiring his house, as it will be many years before the electric light mains will come with reach of his home.

While this work is going on, see what can be done in the way of interesting present customers in heating and cooking apparatus, for a satisfactory business will never be built up on lighting alone, the load-factor is too poor. The electric flat iron is one of the best articles to commence with, as it is a device that is readily understood and appreciated. The introduction of these will soon open a way for a demand for other articles in the electric heating line. One difficulty will be met with, and that is, complaints about the high price asked for these irons. The best way to overcome it is to adopt that successful modern business principle "free trial." Send a form letter around offering a month's free trial, explaining that no charge will be made except for the current used, if it is not desired to retain the iron. Replies will probably only be received from a few people, supply them with irons, and then go around to some of the other customers with the irons, explain their great utility and convenience, and offer to leave one on the terms suggested in the form letter. It will be found that about 50 per cent. of the irons so left will be purchased.

See what can be done to improve the show window lighting of one or two of the bigger shops; the other shops, fired by example, will soon follow suit. Introduce those new and economical lamps—the glower and the metallic filament—the renewal cost is heavy, it must be admitted, but the current consumption being so much less in proportion, means a better satisfied customer, and a better lit shop. Though the receipts will be temporarily reduced, they will soon be found to rise again to the normal, or above it, as usually more and more light is added, and its value is appreciated.

Get daily reports from the canvassers, keep their interest stimulated, and make the whole staff enthusiastic over the new-business getting; it must not all be left to canvassers, for all reap the advantage of increased prosperity.

The great battle that advertising methods have had to fight in the past, has been that it was so difficult to directly ascribe the result in increased business as due to this form of publicity; now, however, it is a recognised fact, and the path of the advocate of advertising is a great deal easier. In starting a new business department, it takes a little time before the results begin to show, but if the department is run on modern lines, they must appear sooner or later. Now, from the business man's point of view, it is desirable to know how much these results cost, so it is essential to prepare a monthly report, based on the canvasser's daily reports, giving statistical details as to the number of customers secured, their connected load, and probable average load; increased connections of existing customers; business discontinued; comparison with results obtained in the same month a year ago; the number of personal interviews; the number of form letters and other printed matter sent out; the total cost, &c.

There is no gainsaying that such a scheme as has been outlined in this series of articles, will undoubtedly mean a considerable expenditure of money; some will even call it a very great outlay, but is must be remembered that it is an investment, and an investment that gives good returns.

By the adoption of a persistent and systematic new business getting campaign, 75 per cent. of the houses in a town can be placed on the customers' list, and the amount spent on electricity raised from the present average of a well-managed plant of about 5s. to nearly 20s. *per cap.* per annum, or even more. By the adoption of a "direct-by-mail" advertising, system, several stations have increased their consumers by over 30 per cent.

This is not mere theoretical calculation or speculation, but a record of actual fact. Such advances as the above, and even greater ones, have taken place in more than one instance, and there is no reason why they should not yet occur in instances far more numerous in the future than in the past. Results like this are encouraging. What has been done once or twice can surely be done again with the assistance of systematic methods, efficiency and push, backed by courtesy, good service and prompt attention—all in the superlative degree.

The whole secret of success is contained in the words—educate your public.

In these notes, in more or less detail, a variety of methods have been dealt with. They are practical, inasmuch as they are the outcome of actual trial and experience, but great caution must be exercised in their application if the best results are to be obtained. An excellent plan under certain conditions may prove an utter failure if insufficiently supported and backed up by those details, which, though apparently unimportant, are essential to success. Hence the need of getting the best of advice when initiating a commercial sales department, in the organisation of which but few have as yet had the opportunity to become experienced, of such recent date is the application of aggressive commercial principles in the development of the sales end of an electricity undertaking. Misdirected efforts in a sales development scheme, producing poor results, are apt to discourage further efforts in a direction which must ultimately prove to be of the utmost value to the undertaking.

SHIFT ENGINEERS.

By W. MAYALL MILNES.

III.—Position, Privileges and Remuneration.

The question of status is, in some stations, a source of friction between the shift engineers and other members of the staff, much of which could be avoided by the exercise of a little tact on the part of the power superintendent or manager, as the case may be.

It will be readily granted by most managers that a good shift engineer is one of the most important factors in running a station efficiently and economically.

The manager has the commercial side of the undertaking to control, in addition to exercising a supervision over the works generally, and his many duties outside the actual station running cannot possibly enable him to devote sufficient time to the station, to watch all the hundred and one little points that tend to economical working. So he has to rely on his shift engineer, to a very great extent, to perform this portion of his duties.

This being so, the shift engineer is deserving of a fair share of consideration at the manager's hands.

In the absence of the manager from the works he should have full control, and should be able to suspend temporarily, any man under him, who so breaks the rules, as to be, in his opinion, deserving of censure, that is, suspend him until he has interviewed the manager, who would then deal with the case.

He should also be given the power of engaging any unskilled labour that may be required from time to time, on breakdowns, or to fill any sudden vacancy that may occur,

such as the temporary absence of coal trimmers, cleaners and such like unskilled labour.

The manager should, if possible, always support the shift engineer's instructions to the men under him, and if they are not quite consistent, in his own opinion, then he should deal with the shift engineer in the privacy of his office. A certain amount of discipline is necessary where a number of men are employed, and it would be impossible to obtain it unless the shift engineer's position is upheld by his superiors.

The shift engineer being such a necessary and important factor in station running, he should be given some compensation for his work, other than his salary, in the form of certain privileges. He should have an office, if the station is over 2,000 KW. capacity, in which to keep records, make out his reports, work out indicator diagrams, and work out his schemes for increased economy, &c. He should have access to all cost and other records, if he does not work them out himself, and be consulted on any alterations in the station that are proposed from time to time.

The question of remuneration is at present a very vexed one. Advertisements for shift engineers, which constantly appear in the technical papers, offer salaries which range from £1 to £3 a week. Surely there must be something wrong here, either £3 is too much, or £1 is too little, as the difference in the responsibilities and qualifications of the men required do not vary in the same ratio.

Whether the station is a small one of 400 or 500 KW. capacity, or one of 20,000 or 30,000 KW., they require a man who has been properly trained as an engineer to run them successfully, one as much as the other, and although the man required for the larger station should be an engineer of longer experience than is required for the smaller station, the essential qualifications are much the same.

If a good man is wanted, and it is only reasonable to suppose so, what does it mean? It has cost him from £50 to £200 in premiums to obtain his practical training, say 15s. per week, in addition to his wage, for board, &c., during his apprenticeship of five years, a matter of £50 for evening classes, books, instruments, private tuition, &c., in all a total of between £400 and £500. For this expenditure he is valued by some at £1 per week. Naturally these advertisers do not get the cream of the profession at their command.

To take the other figure, £3 per week. The man required will be about 28 to 30 years of age. He will have expended the above £450 up to the age of 21, and probably another £50 in technical education afterwards. He will have had a varied experience covering from 13 to 15 years, so that it will not be over-valuing him to rate him at £3 a week.

There is also another view to take. The shift engineer in many stations is rated at 30s. a week, and for this has to control men earning higher wages, such as fitters and wiremen, and sometimes even his drivers are better paid, so that his services are actually valued at less than those of the skilled labourers, whose work he has to supervise.

If a shift engineer has to take an interest in his work, and do everything in his power to further the interests of his employers, he must be paid a fair salary, and this should never be under £2 per week.

This series of short articles on shift engineers and their work has been written with a view of pointing out to young engineers that the position is not merely a stepping stone to something higher, a period which has to be endured, but is in itself an important and very necessary part of the organisation of an electricity supply works, and most certainly is in itself a position that gives an enormous opportunity for the development of individual talents and abilities.

THE FRENCH TELEPHONE SERVICE.

Among other changes in the Government service in France, brought about by the recent change in the French Ministry, there has been an important change in the department charged with the administration of posts, telegraphs and telephones. M. Bérard, Under-Secretary of State for Posts and Telegraphs, whose administration of the important department having control of postal and electrical communication has been much criticised by the Paris Press, has been succeeded by M. Simyan, deputy for Saône-et-Loire. The new Under-Secretary is described as a man of great activity and enterprise, and one of his first official acts was to receive a deputation from the Council of the Association of Telephone Subscribers. It is well known that the inefficiency of the telephone service is one of the greatest troubles of the business world of Paris, and has long been a burning question in the city of light. The Association of Telephone Subscribers was formed several years ago to ventilate the grievances of the telephone-using public and to bring organised pressure to bear on the Telephone Administration in favour of telephonic reforms. M. Bérard had always, more or less politely, as is customary in France, snubbed the Association of Telephone Subscribers and disregarded its representations. M. Simyan, on the other hand, made it one of his first official acts to receive the President and Council of the Association for the purpose of discussing the lamentable situation of the French telephone service.

In the current issue of the *Bulletin* of the Association an account is given of this interesting interview.

The Marquis of Montebello, President of the Association, in his address to the new Under-Secretary of State, gave a review of the work of the Association, and stated that it was the desire of the Association, for the benefit of the public at large, to maintain good relations with the Administration of Posts and Telegraphs. He described briefly the work that had been done, and pointed out that the Association had over 7,000 members, and had presented a petition to the Chamber of Deputies, praying for improvements in the telephone service, containing no fewer than 25,000 signatures. The only object of the Association is to obtain an improvement in the postal, telegraphic and telephonic service, and it is animated by no prejudice against the Administration. The work of the Association had been approved by M. Sembat, the reporter of the Budget of the Department of Posts and Telegraphs, in Parliamentary debates, but its representations have been disregarded by the previous Under-Secretary.

M. de Montebello said that among the principal reforms advocated by the Association were a complete revision of the regulations governing the telephone service and the subscriber's contract, an improvement in the efficiency of the staff, and an improvement in the equipment of the Paris system. It was pointed out that in 1904 the Administration had promised to revise the regulations and suppress some of the very strict and arbitrary rules imposed upon telephone subscribers, some of which had been declared by legal authorities to be opposed to the common law. Nothing had so far come of this promise.

As regards the staff, the President of the Association said that, while there was no doubt as to the good intentions of the staff as a whole, there was equally no doubt that many of the employés were not competent to carry on the very technical work of the telephone system. The Association desired that the staff should be reorganised and its various departments specially trained to meet the requirements of the work.

As regards the equipment of the system, M. de Montebello noted with pleasure that the new Under-Secretary, according to an interview published in one of the daily papers, had expressed his anxiety to effect reforms. He went on to say that the Association had some time ago pointed out the deficiencies of the Paris telephone system, and had made a study of modern telephone engineering methods, and had impressed upon the Administration the importance of adopting the common battery system, as was shown by the investigations made by the Association, and by the very complete reports of Mr. Laws Webb, the Association's consulting engineer. The Association had also pointed out that the exchange equipment and junction lines at present in use had not sufficient capacity to cope with the work.

Dealing further with the question of equipment, M. de Montebello enlarged on the inadvisability of maintaining primary batteries at the subscribers' stations, according to the present intention of the Administration, the proposal now under consideration being to adopt common battery signalling only, and not common battery talking. He insisted that a complete common battery system should be

adopted, and urged that the additional expense of replacing the subscribers' instruments would be comparatively small, while there would be a great saving in working expenses if the local battery instruments at the subscribers' stations were abolished.

Finally, the President of the Telephone Subscribers' Association made the following requests :—

1. That the Association should be considered as an institution able to help both the Administration and the public.

2. That the Association should be represented on the Committees appointed by the Administration to deal with telephone questions.

3. That instructions should be given to the principal telephone officials that they should give proper attention to complaints addressed to them by the Association on behalf of its members, and thoroughly investigate and report on these complaints.

M. Simyan, in his reply to these remarks, stated that he was animated by the best intentions towards the Association, whose usefulness he thoroughly recognised. He proposed to devote himself to a prompt and radical improvement of the various branches of the telephone service. As regards the regulations governing subscribers' contracts, after studying the various points raised by the legal adviser of the Association, he would do his best to give prompt effect to the recommendations made.

As regards the staff, the Under-Secretary admitted that alongside a large number of expert and diligent employés there were some who were careless and inefficient, but he would do his best to eliminate these latter. He fully recognised the necessity of thorough training and of eliminating those not suitable for the work. He proposed to establish a training school for the telephone staff along the lines adopted by well-organised telephone concerns in other countries.

As regards the equipment of the Paris telephone system, M. Simyan said he fully recognised the importance of this question. The present proposal is to reconstruct the Paris exchanges and to adopt the common battery system, as far as the credits demanded and adopted by Parliament will allow.

As regards the general system, it is proposed to increase the number of long-distance lines, and with this end in view, it is proposed to pay interest on the loans advanced to the State by Chambers of Commerce and provincial bodies (which loans have hitherto had to be supplied without interest) for the purpose of constructing long-distance lines.

Finally, the Under-Secretary repeated his expressions of goodwill towards the Association, and stated that the Association should be represented in future on the Telephone Committees appointed by the Administration, and that instructions should be issued to the principal telephone officials that proper attention must be given to complaints emanating from the Association.

It is evident, from this summary of the speech of the new French Under-Secretary of State for Posts and Telegraphs, that he admits that serious reforms in the French telephone systems are necessary, but whether such reforms will actually be effected, or whether these amiable official assurances will be followed by another long period of inaction and delay, remains to be seen. Anyone at all familiar with the deplorable state of disorganisation of the Paris telephone system, both as regards staff and equipment, will realise that M. Simyan has some very difficult work before him in order to bring about a general and lasting improvement.

EXHIBITION OF APPARATUS.

The Physical Society of London held their second annual exhibition of apparatus on the 14th inst., at the new buildings of the Royal College of Science. The collection was not very large, nor were there any striking novelties, but some interesting pieces of apparatus were shown.

The Cambridge Scientific Instrument Co. had an oil bath oscillograph made in a very small size, with ingenious adjustments. The moving parts were mounted on a plug or slide, capable of withdrawal from the remainder of the instrument. The whole is a very beautiful piece of work on the small scale.

They also showed two chronographs, one with a large smoked cylinder and a tuning fork ; the other, using three inking pens, making parallel traces on a Morse slip, and displaced sideways to mark the signal. The latter form is exceedingly convenient for many purposes, especially where observations extending over a long time have to be recorded. It is used, for instance, for recording the fall of temperature, and the recalescent points of iron and steel.

In an ingenious temperature recorder, a mercurial thermometer is hung on a beam in such a way that the balance is affected by the expansion and contraction of the mercury in the tube. A long index pointer attached to the balance moves over the revolving drum, and is pressed against it at irregular intervals by a bar attached to the driving clock. The inking point is the intersection of a knife edge on the pointer, and of an inked string stretched along the drum, an arrangement which saves the use of any extra weight on the pointer, and seems to be very effective.

A suspended frame for carrying a galvanometer or other instrument steadily from a support liable to be shaken, contained a flat tray of liquid, the friction of which brought the frame quickly to rest after it had been started swinging. Many optical appliances were shown—projection lanterns, including a very good one by Ross, petrological and metallurgical microscopes, and spectroscopes.

Carl Zeiss & Co. showed microscopes for use in mechanical work, and for measuring linear dimensions. The eyepieces had cross wires, and the microscopes were mounted on slides with traversing micrometer screws, divided to ·01 mm. Trial with a test object showed that a displacement of ·001 mm. (1 micron) could be detected, which is sufficient for fine mechanical work such as small workshop gauges, and parts of fine machinery.

Dr. W. M. Watts showed binocular spectroscopes. This instrument has the appearance of an ordinary binocular, and is fitted with a diffraction grating over each object glass. Directed to one side of a luminous object, a highly-dispersed spectrum is seen with both eyes. The characteristic spectra of various metallic salts in a Bunsen flame, seen through a slit, were well defined and very conveniently observed.

Messrs. A. Wright & Co. showed the Simmance and Abady combustion recorder, which records on a travelling chart at short intervals the velocity of flue gases, and the percentage of carbonic acid. The operation is a complicated one, involving the withdrawal of a known volume of gas, the absorption of the CO_2 with caustic soda, and the record of the loss of volume. The remaining gas has then to be expelled, and then a fresh charge drawn from the flue. A sensitive pressure gauge keeps a continuous record of the velocity in the flue, so that the total quantity of flue gases passing and the percentage of CO_2 can be ascertained.

Mr. Paul showed Campbell's bifilar galvanometer and a vibrationless moving-coil galvanometer ; Messrs. Nalder Bros. & Thompson showed electrostatic insulation testing machines, and there were a considerable number of ordinary testing instruments and pyrometers shown by different firms. Messrs. Elliott Bros. showed some quadruplex telegraph instruments, but among the electrical apparatus we saw little that was particularly novel.

Electricity in German Mines.—It is proposed to proceed with a scheme for the supply of electrical energy to the industrial works and mines in the district of Siegen, now that the local authorities of Siegen have approved the expenditure of a considerable sum for the extension of the existing electricity works. This step has been decided upon in order to render the industrial works more independent of supplies of dear coal, and also to effect economy in the consumption of coal. It is hoped, by the supply of cheap power, to be able to keep in operation specially those mines which, having reached a depth of 500 metres, are only worked at a considerable loss of steam power, and consequently of coal in the maintenance of the pumping machinery in operation. All mines and industrial works within a radius of 15 miles are to be connected with the power station by means of underground cables, and at a later date it is proposed to erect gas engines in connection with the blast furnaces, for driving electrical generators.

THE LONDON TELEGRAPH TRAINING COLLEGE.

WE recently paid a visit to the College above-named, which has been established at Morse House, Earl's Court, S.W., by Mr. H. W. R. Child. The staff comprises Mr. Maurice Child, in charge of the wireless telegraph and technical department; Mr. G. P. Grenfell, over the submarine cable department; and Mr. F. Percival, over the inland department, who have gained practical experience in the service of Lloyd's Marconi Wireless Telegraph Division, the Eastern Telegraph Co., and the Central Telegraph Office, respectively. The College is licensed by the Government for wireless telegraphy, and possesses an outside aerial about 100 ft. in height; training in "wireless," in fact, is made a special feature of the courses of instruction provided, and several rooms are allotted to this purpose, in addition to an outdoor "cabin." Practical instruction in sending and receiving wireless messages is given under commercial conditions, and it is interesting to note that not only are messages picked up from various sending stations near London, but Poldhu itself can be utilised, suitable adjustments being made; the students are thus enabled to work under conditions practically identical with those obtaining on board ship in mid-Atlantic. Most of the wireless apparatus is new, several systems being represented, and the adjustments are carried out by the students themselves.

In the submarine cable department, siphon recorders and mirror instruments are provided, and in the inland department, besides the usual manual apparatus, sounders and printers, the Wheatstone transmitter, perforator, &c., are employed. The duplex and quadruplex systems are taught. The various rooms are connected by wire circuits which pass through testing boards, where any desired connections can be made. A battery of small accumulators provides the necessary current, and is charged from the supply company's mains by a Crypto motor-generator.

Ample room is available for a large number of students, including a lecture room where theoretical instruction is given. In view of the probable developments of wireless telegraphy, and the continual growth of submarine and inland telegraphy, the prospects of the College seem to be very favourable.

PROCEEDINGS OF INSTITUTIONS.

The Heating Coefficient of Magnet Coils.

By G. A. LISTER, B.Sc.

(*Abstract of Paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS *at Birmingham, December 12th*, 1906)

THE heating coefficient as applied by the designer of electrical machinery is expressed by—

$$C_h = S_w \cdot t.$$

where t = Mean final temperature rise in degrees Centigrade.
S_w = Coil surface in square centimetres per watt dissipated.
C_h = Heating coefficient.

The mean final temperature rise is given by the difference between the mean temperature of the coil when it has reached a steady value, θ_2, and the temperature of the surrounding air, θ_1. The method of measuring the temperature of the coil by a thermometer is unsatisfactory. The safer way is to determine the temperature by calculation based on the observed increase of resistance. This gives the mean temperature throughout the coil, and is the method which has been used in the tests here recorded. The actual resistances are conveniently determined by means of a voltmeter and ammeter. Care, however, must be exercised, as an error in estimating the resistance is considerably magnified in the final result. Again, the current taken by the voltmeter, if allowed to pass through the ammeter, may easily introduce an error of as much as 5° of temperature. It is also preferable that the resistance of the coil when cold be measured by the same instruments as those which will be used during the test, the measurement being taken as soon as the current has reached a steady value after switching on.

The ratio of the maximum to the mean temperature of a coil varies with its dimensions and design, and on the conditions under which it is worked. The following average values of this ratio are taken mainly from Mr. Rayner's report to the Engineering Standards Committee. Mr. Rayner's tests were made on machines ranging from 25 to 500 KW.

Conditions.	Ratio. Max. temperature / Mean temperature.
Stationary coil without core	1·12
Coil in place on machine	1·17
" " machine running light ...	1·15
" " machine fully loaded	1·175

Very few values are over 1·2, and this is consequently a safe figure to employ when estimating the maximum temperature of the field coils of fully loaded machines.

There is a diversity of opinion as to what portion of the coil surface should be taken in expressing the surface to be provided per watt dissipated in the coil.

Messrs. Neu, Levine and Havill, in tests on small Crocker-Wheeler motors, found that the temperature rise for a given amount of energy dissipated, was considerably greater when the coil was supported in air than when placed in position on the core of the machine.

Mr. Rayner observed no extra cooling due to the iron core. My own tests show a slight increase in the temperature rise when the coil is placed on the core, this small effect occurring both with taped coils and with coils wound on a metal former. In view of the fact that the temperature rise differs so very little in the two cases, it seems preferable to consider the total surface of the coil when dealing with the surface per watt, and to use a "heating coefficient" which will combine the effects of radiation, conduction and convection.

The heating coefficient varies with the speed and with the load, with the nature of the surface of the coil, the method of securing the coil to the machine, the ventilating properties of the rotating armature, and generally with the design of the machine. If all these conditions remain constant it will still be found that the coefficient varies with the final temperature attained by the coil.

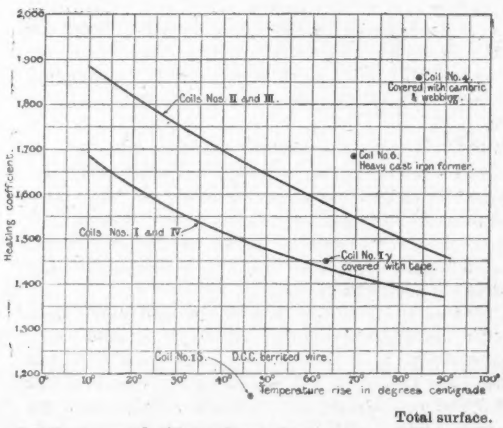
The following curves show the variation of the temperature rise with the watts absorbed for various types of coils and under varying conditions. In cases where it should prove useful, the heating coefficient has also been plotted.

Four conditions have been considered:—

1. The coil supported in air.
2. The coil in place on the machine, with the machine stationary.
3. Machine running light at normal speed.
4. Machine running fully loaded at normal speed.

Some of the results recorded have been taken from the papers previously mentioned. In each such case the points are plotted in a distinctive manner (cross in circle). Particulars of these coils, so far as they are available, will be found in Table II, also full references to the original papers.

My own tests were made systematically, and every precaution was taken to ensure accurate results. The resistance of the coil at 0° C. was calculated by using the standard temperature coefficient of 0·428 per cent. increase of resistance per degree rise. Each measurement of final temperature was made after the coil had been carrying current for a period averaging about 10 hours, thus ensuring that


Heating coefficient.
Temperature rise in degrees centigrade
Coil No. 4, Covered with cambric & webbing.
Coils Nos. II and III.
Coil No 6, Heavy cast iron former.
Coils Nos. I and IV.
Coil No. Iγ covered with tape.
Coil No. Iδ
D.C.C. berrited wire.

	Total surface.
Coil No. I covered with two layers of tape	960 sq. cm.
Coil No. II covered with mica and tape	1,075 sq. cm.
Coil No. III heavily insulated with mica and taped	2,530 sq. cm.
Coil No. IV wound on sheet-iron former	2,100 sq. cm.

FIG. 1.—HEATING COEFFICIENT OF COILS SUPPORTED IN AIR.

perfectly steady temperature conditions had been reached. Full particulars of the six coils tested will be found in Table I. The figures for the watts per sq. cm. are based upon the total surface of the coil.

1. *Coil Supported in Air.*—In my tests the coils were supported on three points, from 4 in. to 6 in. above the surface of a table. Four coils were tested in this manner, and the results will be found plotted in fig. 1. Points obtained from published data are also plotted.

The results show clearly the effect of the covering of the coil on its heating.

An interesting fact is the remarkably small temperature rise of Coil Iδ. It was identical with Iγ, except that it was wound with d.c.c. berrited wire. In the discussion on Mr. Rayner's paper, Mr. A. F. Berry stated that such enamels would stand high temperatures, and suggested their use as a means of reducing the cost of produc-

TABLE I.—DETAILS OF THE COILS TESTED AT THE BIRMINGHAM UNIVERSITY.

No. of coil.	Type of machine.	Capacity of machine.	Normal speed in revs. per min.	No. of poles.	Excitation voltage.	Size of core in cm.	Average section of coil in cm.	Covering of coil.	Former.	Total surface of coil and former in sq. cm.	No. of turns per coil.	Size of wire. S.W.G.	Insulation of wire.	Resistance per coil at 0° C.	Remarks.
I.	—	—	—	—	—	10·25 × 5·0	6·5 × 4·75	Thin presspahn adjacent to coil. Taped and varnished.	Nil	960	2,270	21	S.C.C.	30 050	—
II.	—	—	—	—	—	12·50 × 11·5	4·5 × 4·50	A covering of mica. Taped and varnished.	Nil	1,075	—	19	D.C.C.	40·000	—
III.	—	—	—	—	—	—	5·0 × 2·50	Thick mica insulation round embedded portion. Taped.	Nil	2,530	—	11	D.C.C.	0·227	Stationary armature coil of alternator.
IV.	Semi-enclosed motor.	10 B.H.P.	1,000	4	220	12·40 × 11·5	10·5 × 6 00	Varnished... ...	Sheet iron	2,100	3,010	1·065 mm.	D.C.C. 10 mils	33·310	Two similar machines, each tested.
V.	Protected generator.	7·5 KW.	700	4	220	15·00 × 10·5	8·0 × 4·25	Varnished... ...	Sheet zinc	1,815	—	—	—	29·850	Generator of booster set.
VI.	Open type motor.	36 5 H.P.	625	4	110	16·00 × 13·6	13·8 × 8·50	Partly bound with tape and string.	Nil	3,400	655 445	12 13	S.C.C. 8 mils	3·000	Motor-generator.
VI*a*.	Open type generator.	24·0 KW.	„	„	150	„	„	Ditto	Nil	„	600 900	13 14	S.C.C. 8 mils	5·825	ditto.

TABLE II.—DETAILS OF THE COILS USED BY MR. E. H. RAYNER, MR. E. BROWN, AND MESSRS. NEU, LEVINE AND HAVILL.

No. of coil.	Reference.	Type of machine.	Capacity of machine. KW.	Normal speed. R.P.M.	No. of poles	Excitation voltage.	Covering of coil.	Former.	Estimated total surface of coil and former in sq. cm.	Remarks.
1*a*	Mr. E. H. Rayner	Shunt motor	26 5	850	4	440	Empire cloth and tape	Nil	2,620	—
1*γ*		„	26·5	850	4	440	Empire cloth and tape	„	„	—
1*δ*		„	26·5	850	4	440	Nil	„	„	Berrited d.c.c. wire
2		„	75·0	305/550	6	550	Two layers tape	„	5,270	Coil impregnated
3		„	75·0	600	6	500	Varnished only	Sheet-iron	4,020	—
4		Compound motor	82·0	265/360	6	500	Three layers cambric, Four layers boot webbing	Nil	3,320	Series winding all at one end of shunt coil
5		Shunt generator	147·0	180	4	210	Varnished only	Brass	13,000	—
6		„	200·0	350	6	220	Varnished only	Cast-iron	11,320	—
8		„	500·0	320	8	480/600	Canvas, paper, leatheroid, string—total ¼ in.	Nil	11,700	—
9		„	500·0	200	10	200	Canvas, fuller board, millboard, string	Brass and sheet-iron	12,400	—
A	Mr. E. Brown...	Shunt motor	7·5	1,250	2	135	Nil	Part wood	—	—
B	Messrs. Neu, Levine & Havill	Shunt motors	1 H.P. 5 H.P.	—	2	—	—	—	—	—

TABLE III.—HEATING COEFFICIENTS OF FULLY-LOADED MACHINES.

Type of machine.	Output.	Voltage.	Speed.	Covering of coil.	Former.	Reference to Tables I and II.	C_h.	Sq. cm. per watt.	Watts per sq. cm.
Two-pole shunt motor, armature above magnets ...	7½ KW.	135	1,250	Nil.	Part wood	A	1,025	20·5	0·049
Four-pole semi-enclosed shunt motor	10 H.P.	220	1,000	Nil.	Iron	IV	3,300	66·0	0·015
Six-pole shunt motor... ...	75 KW.	550	325	Two layers tape	Nil	2	1,190	23·8	0·042
„ „ „	75 KW.	500	600	Varnished	Sheet iron	3	1,220	24·4	0·041
Six-pole compound motor ...	82·5 KW.	220	350	Cambric and boot webbing	Nil	4	2,380	47·6	0·021
—	—	—	—	Above removed	—	—	1,870	37·4	0·027
Eight-pole shunt generator ...	500 KW.	480-600	320	Canvas paper, leatheroid, and string	Nil	8	1,565	31·3	0·032

tion. Engineers generally would welcome further information respecting such coils.

2. *Coils in Position, Machine Stationary.*—Two typical heating coefficient curves are given in fig. 2.

Slightly greater heating takes place when the coils are in position on the core. In all cases, however, this increase of temperature rise is small, and the results justify the system of basing the heating coefficient on the total surface of coil and former.

Coil V shows the least heating. It was the smallest coil tested, and was wound on a zinc former fitting very closely to the core. Coil VI (without former) was practically in contact with the core only at the corners. The heating coefficient does not depend on the size of the wire. The curves show the tendency of large coils to heat more than small ones. Experiments to determine the variation of heating due to this cause would be extremely useful.

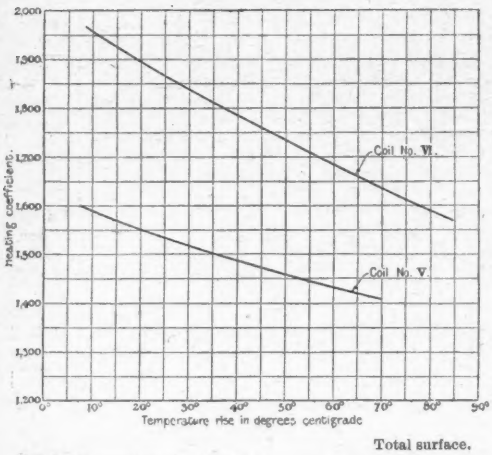
3. *Machine Running Light at Normal Speed.*—The ventilation caused by the rotating armature must vary considerably under different conditions. It certainly varies with the general design of the machine, and with the peripheral speed of the armature. It probably varies also to an extent which is quite appreciable with the air-gap, the ratio of pole surface to pole pitch, and the design of the armature end connections. In reference to the latter, the direction of rotation of the armature may also affect the ventilation.

It seems, therefore, that the temperature rise of field coils when the machine is running, cannot readily be predetermined, unless based on experiments made on machines of similar design.

Mr. E. Brown's tests on a small two-pole horse-shoe-magnet type machine (a few particulars of which are given in Table II), show to some extent the variation of coil heating with speed. From his temperature-grade curves, I have estimated the mean temperature rise of the coil, and have plotted these figures against the peripheral speed of the armature, as shown in fig. 3. These curves show the kind of variation which may be expected in similar machines.

The two semi-enclosed 10-H.P. motors to which Coil IV belongs, show very little advantage due to the revolving armature (see fig. 4). This is probably due to the enclosed design, and to the proximity

of the commutating poles with which these machines are provided. In connection with the tests on these two machines, it was noticed that when running, the coils on one machine heated appreciably more than those on the other. The machines are of exactly similar design, and are mounted in line on a common foundation. A clutch



	Total surface.
Coil No. V wound on zinc former	1,815 sq. cm.
Coil No. VI no former, very little covering ..	3,400 sq. cm.

FIG. 2.—HEATING COEFFICIENT OF COILS IN POSITION, MACHINE STATIONARY.

is provided for coupling them together, half of which is keyed to each motor spindle. The commutator end is thus in each case outside. The armatures revolve in opposite directions with respect to the slope of the free portions of the armature winding, and it is noticeable that the machine (motor *a*) running against this slope works appreciably cooler than the other (motor *b*). The pressure of the air entering and leaving the machine was found to be appreciably greater in the case of machine *a* than with machine *b*.

4. *Machine Running Fully Loaded.*—The heating of field coils when the machine is fully loaded depends to a large extent on the temperature rise of the armature, also upon the efficiency of the ventilation under full-load conditions. The figures for the heating coefficient consequently vary considerably.

Fig. 3 shows the increase of heating due to full-load, in the case of the machine tested by Mr. Brown, to be about 15 per cent. at normal speed.

Fig. 4 shows the heating with various armature currents of the field coils of the 10-B.H.P. semi-enclosed motors. The rapid increase with overload is probably due in a large measure to the close proximity of the series-wound commutating poles.

In Table III will be found the values of the heating coefficient for fully loaded machines, of which data are available. In each instance the total surface is taken into account, and the figure is quoted for a final temperature rise of 50° C.

The variation in these figures, and the consideration of the numerous and uncertain conditions introduced by the rotating armature, show that it is not possible at present to fix any very definite figures for the heating coefficient of fully-loaded machines.

Conclusion.—The tests and figures here recorded confirm the following points which have already been pointed out in connection with the heating of magnet coils:—

(*a*) The maximum temperature rise of a magnet coil seldom exceeds 1·2 times its mean temperature.

(*b*) The effect of the covering of the coil on its temperature rise is very marked. Such coverings should be reduced to a minimum, as also should the insulation thickness to core or former.

(*c*) A large coil heats slightly more than a smaller one for the same watts per sq. cm.

(*d*) Berrited wire produces a considerable reduction in the temperature rise.

I have also come to the following additional conclusions:—

(*e*) The heat-removing property of the iron core differs very little from that of the surface of the coil exposed to air, and consequently it is best to consider the whole surface of the coil and former when dealing with the heating coefficient.

(*f*) The heating coefficient drops considerably with increase of the final temperature rise.

(*g*) From the point of view of cooling, a slight advantage is obtained with a coil wound on a metal former.

(*h*) A great deal may be done to secure cool running by cultivating a draught by means of the armature end connections, and by running the machine in the direction giving the maximum fan action.

Taking into account the whole of the data here given, I would suggest the following approximate values of the *heating coefficient* for a 50° C. rise, based upon the whole surface of the coil:—

1. SUPPORTED IN AIR.

	C_A.
Medium size plain coils, taped	1,500
" " " " mica and tape ...	1,650
" " " " heavily covered ...	1,750 to 2,250
" " coil, wound in metal former uncovered	1,500
" " berrited d.c.c. wire	1,150

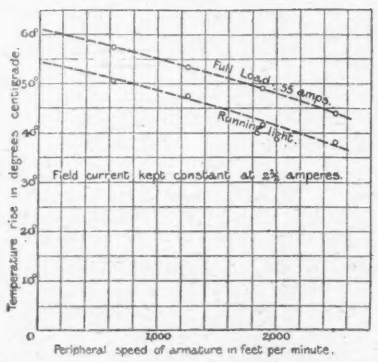
2. IN PLACE ON MACHINE.

Medium size plain coil	1,750
" " wound in metal formers which slip loosely over core...	1,550

3. MACHINE FULLY LOADED.

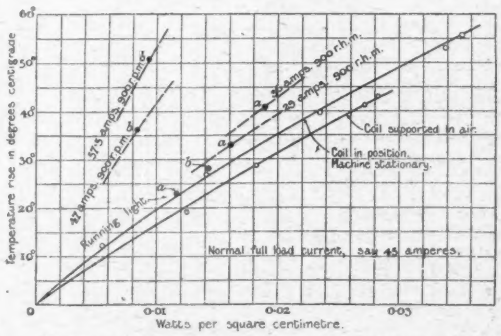
Small two-pole machines, armature above magnets	1,000
Moderate size protected motors	2,000
" " semi-enclosed motors	2,500
" " semi-enclosed motors with commutating poles	3,000
Open-type machines, 50 KW.	1,250
" " 500 KW.	1,500

There is an unfortunate lack of published data regarding the variation of the coefficient in different types and sizes of machines, when running under full-load conditions. It is to be hoped that some test-room engineers will publish the results of their experiences in this direction.



Two-pole machine with armature above magnets, tested by Mr. E. Brown. See Table II.

FIG. 3.—VARIATION OF TEMPERATURE RISE WITH SPEED, COIL A.



Two 10-B.H.P. 220-volt semi-enclosed motors, 1,000 R.P.M., fitted with commutating poles. For details of Coil see Table I. Motor A was run in the direction giving the better fanning action. Motor B was run in the direction giving the worse fanning action.

FIG. 4.—VARIATION OF TEMPERATURE RISE OF COIL IV.

Some Phenomena of Commutation.

By Prof. F. G. BAILY, M.A., and W. S. H. CLEGHORNE, B.Sc.

(*Abstract of Paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS *at Glasgow, November 13th*, 1906.)

THE contact resistance between dry carbons and a polished copper cylinder was determined at speeds ranging from 860 to 3,300 ft. per minute and with pressures from 7 to 46 oz. per sq. in. The carbons were the X quality of Le Carbone Co., a dense graphitised carbon of 0·00193 ω specific resistance, 1 sq. in. in section. It was found that the speed had no direct influence on the results, which could be expressed in the following form:—

$$k\,\text{E} = i^{0\cdot28},$$

where E is the drop in E.M.F. due to the contact resistances and i the current strength. The value of k was fairly constant for each pressure, and agreed very closely with the expression $k = 1 + 0\cdot22\sqrt{\text{P}}$, where P is the pressure in ounces per sq. in. Thus, between the limits named, and with a well-bedded brush free from vibration,

$$\text{E} = i^{0\cdot28}/(1 + 0\cdot22\sqrt{\text{P}}).$$

This applies directly to plain collecting rings, but is not strictly correct for commutators, owing to the unequal distribution of current in the latter. Imperfect bedding has very little effect on the value of E, and therefore, with a given spring pressure and current, there is no advantage in using a low current density. The

friction is also independent of the size of the brush, under the conditions named.

Th eotal losses at each speed are a minimum for a certain ratio between current and spring pressure; at high speeds (3,000 ft. per minute) the ratio is 4 : 1, and at low speeds (500 ft. per minute) 1·3 : 1; Mr. Hobart gives 40 amperes and 20 oz. per sq. in. as good practice, a ratio of 2 : 1, which agrees fairly with the values obtained except at the highest speeds.

The power wasted in friction is given by $W = \mu v P A$ in watts, where v is the velocity in feet per second, and A the area in sq. inches of both brushes; the value of μ may be taken as 0·0005, falling somewhat at high speeds due to vibration.

Lubrication with paraffin wax and compounds containing it, produced unexpected results; the contact resistance was not in the least increased, but nevertheless the friction was greatly reduced, μ becoming about 0·00011. Thus the pressure can be increased to 30 or 40 oz., and current can be collected over a large range of current density at a total loss of less than 2 watts per ampere. Liquid lubricants were found to be useless.

The effect of vibration was investigated, and it was shown that serious losses resulted therefrom, which were not much affected by lowering the current density. The resistance of the contacts at standstill was also measured; the conductance varied with the pressure according to the formula

$$i/E = 0{\cdot}6\,P + 24.$$

Experiments were next made on actual commutators, the P.D. between brush and segment at the moment of separation being recorded with the Duddell oscillograph. A Morris-Hawkins 15-H.P. four-pole enclosed motor, running at 550 R.P.M., with 460 volts, was tested; this machine had compensating poles, and was intended for a wide range of speed. The motor was under-compensated, the P.D. rising to 20 volts at high speed with weak field, but there was very little visible sparking; on cutting out the compensating poles the sparking was considerable, and the P.D. rose to 32 volts, the high value being partly due to the presence of the idle poles. An uncompensated six-pole motor of 55 H.P., made by Messrs. Mavor and Coulson, was also tested; this ran at 500 R.P.M. with 460 volts. The "sparking voltage" was found to be in the neighbourhood of 3 or 4, the brushes being moved according to the load.

The magnetic field of the compensated machine was investigated, and it was found that the commutating poles were saturated at about half load. By experiments described in the paper, it was shown that very detrimental results might ensue from the use of incorrectly designed commutating poles. The motor in question was one of the first produced by the makers, and ran with little sparking even at high speeds. The risk of using too broad a brush is emphasised by the authors, this increasing the tendency to sparking, without gain in other directions.

Lastly, the authors examined the rise and fall of the actual current flowing into a commutator segment, by means of a condenser method. The 55-H.P. motor above mentioned was used, the test being made at the negative brush. The accompanying fig. 1 shows how the current was found to vary with the brush in the neutral position; similar tests were made with the brush before and behind this position, with correspondingly modified results. Fig. 2 shows the abnormal case, with the brush advanced. The lower curves show the P.D. between brush and segment and the position of the brush at any instant is shown by the diagram in the centre of the figure.

The current rises very rapidly at first, then falls, owing to the brush resistance and, when it is present, to the reversing field.

The high P.D. just before contact is due to the leakage field; in addition to this, the resistance of bsush contact with the preceding segment forces the current into the new one with an E.M.F., which increases with the current, and in fig. 2 the latter is the principal factor, as shown by the rates of rise of the current. The current begins to fall before the mid-position is reached, but in fig. 2 the presence of leakage from the approaching pole maintains the current, until it is quickly brought to zero by the increasing brush resistance. It is pointed out that the whole line current passes through the leading segment, even when the larger portion of the brush is touching the segment behind it; this supports the authors' statement that excessive brush area serves no useful purpose. Moreover, in this instance the current density was very high, as only one brush arm was used instead of three (the machine having six poles), to simplify the experiments, and the brush surface was only one-ninth of the surface supplied by the makers; the tests were, for this reason, carried only to half the normal load (55 H.P. full load, at 460 volts, 480 R.P.M.).

The authors emphasise the fact that the leading edge of the brush is really the important current-carrying part, and that the trailing edge should be reduced to its narrowest limits. The leading half should be of the best carbon, while the trailing half should have a much higher resistance; there is no need for several laminations. They also point out that the brush has far more power to commutate the current than is usually believed—in fig. 2, for example, commutation takes place without a reversing field, and with only one brush arm in use, commutating three coils at once. Therefore, if the stray field is kept away from the short-circuited coil, the strength of the main field may be reduced to any extent.

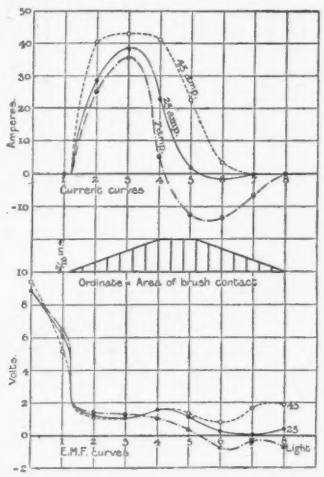


Fig. 1.—Current and E.M.F. in Segment, Brush in Neutral Position.

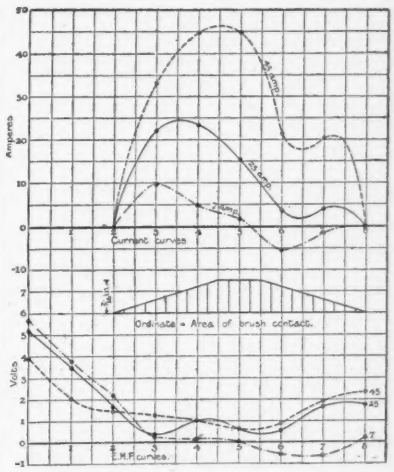


Fig. 2.—Current and E.M.F. in Segment-Brush in Front of Centre.

LEGAL.

The Surveyor of Taxes v. Wallasey U.D.C.

Mr. Justice Bray gave judgment in this case on 18th inst. The question at issue, according to the *Liverpool Daily Post and Mercury*, was whether an Urban Council purchasing horse tramways from a tramway company and converting them into electric tramways were to pay income-tax on the first year's profits of the new tramways as upon a new business, or whether they were entitled to average the profits of the three years, and pay upon that basis as successors of the old company. The difference in the present case, it was said, was material, inasmuch as in the first year of the working of the Wallasey electric trams the profits were over £12,000, whereas the average earnings of the old company were about £2,000 a year; but after deducting from the £12,000 earned by the new company in its first year's working, the amount allowed by the Income-Tax Act for depreciation of machinery, &c., there were no profits at all on which income-tax could be assessed. It appeared that the Wallasey District Council purchased the tram way undertaking of the Wallasey Tramways and Omnibus Co., converted the old horse line into an electric line, and extended the mileage from between three and four to from nine to ten miles.

His Lordship, in giving judgment, held that the respondents were entitled to take over the tramway business, and accordingly, that they were within the meaning of the Act successors to the old Tramway Co., and entitled to the three years' average. He accordingly gave judgment for the respondents, with costs.

Bradlaw v. Dublin United Tramways Co.

This case, an application for discovery of documents in which came before Mr. Justice Boyd recently, is brought by a dentist for £5,000 personal injuries alleged to have been sustained by him through the negligence of defendants in not keeping the setts on the tramway track in proper order. It was stated by counsel that the case was similar to the Fitzgerald case, which went to the House of Lords. Mr. Justice Boyd granted the application, directing the secretary to the defendant company to make the affidavit of discovery.

Cork Electric Tramway and Lighting Co., Ltd., v. Waldron.

At Dublin, on December 16th, judgment was given for plaintiffs in an action against a Queenstown consumer (Mrs. Waldron). Plaintiffs sought to recover £45 3s. 2d., the price of electric light alleged to have been supplied, and for meter rent from 1904 till 1906. Defendant said there was an agreement that she should be supplied at the rate of £12 per annum, and that she had made two half-yearly payments of £6 each, also that she only owed £11, which she offered to pay. Plaintiffs denied the making of such an agreement, and declared that defendant had signed the company's usual agreement.

In re The British Power Traction and Lighting Co., Ltd.

In the Chancery Division of the High Court of Justice on Thursday last week, Mr. Justice Warrington had before him an application to fix a day next sittings for the hearing of the claims by the Halifax Joint Stock Banking Co. and others against the British Power, Traction and Lighting Co.

Mr. Cave, K.C., who made the application, stated that the claims were by a number of creditors, and it would be necessary to bring up a number of witnesses from the country.

His Lordship said there was a difficulty in fixing a day at present, but counsel could renew his application next sittings.

E

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Smith's Electric Light Fittings.

We have already given fairly full particulars concerning the simplified wiring system of Messrs. J. F. Smith & Co. (see Electrical Review, October 19th, 1906, page 638), and we have now had an opportunity of seeing these patent fittings in operation at the firm's showroom in Edmund Street, Birmingham. It will be observed from the accompanying illustrations (fig. 1) that the

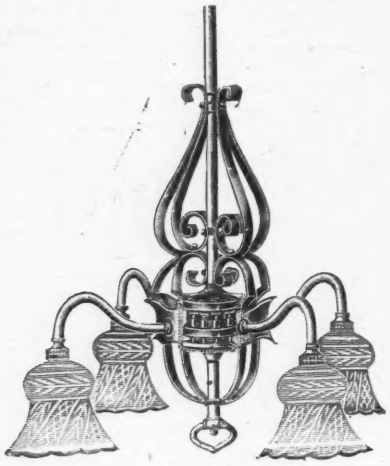


Fig. 1.

special switching device is placed at the interior of the body of an electrolier, and by turning the switch handle at the bottom the required number of lights is put "on." A pilot light on the fitting is first switched on as one enters the room. In fig. 2 the principle of the switching device is shown. It is claimed that by this device

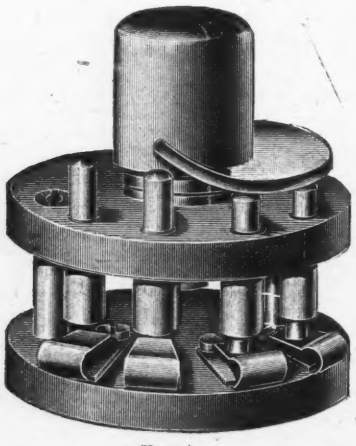


Fig. 2.

the complication of ordinary switch wires generally taken from a fitting to the door is obviated. We understand that Messrs. Smith have applied their system in the conversion of gas and oil lighting fittings, and also that it has been received with approval by fire insurance authorities.

The Statter Time Lag.

In the accompanying illustration (fig. 3) we show an application to a motor-starter of the Statter time lag device, of which a full description has already appeared in the Electrical Review. By means of this device, a motor is secured against accidental damage from overloading, and the user is protected against annoying stoppages caused by momentary overloads that will not damage the motor. It is recommended that, for motors properly rated, the best rule to adopt is to set the scale of the time lag 5 per cent. above the rated capacity of the motor in amperes. The time lag is claimed to allow of the use of an economical motor of the right size for its work.

In a circular before us it is explained that the Statter patent time lag has a true inverse time element, extending over many minutes in the case of mild overloads, and falling to zero in the case of a dangerous short circuit. The appliance protects the insulation of motors, &c., from the injurious effects of overheating at all overloads to 50 per cent. above full load.

The apparatus made under Mr. Statter's patents by the Switchgear Co. covers the following grounds:—

Various patterns of maximum and combined maximum and reverse circuit-breakers from 100 to 5,000 amperes to which the time lag is applied as an integral part.

Various patterns of separate time lags applicable to well-known makes of existing circuit-breakers.

Motor-starters provided with time lags.

A separate time lag in a case, applicable to all existing motor-starters that are equipped with a no-load release magnet, having

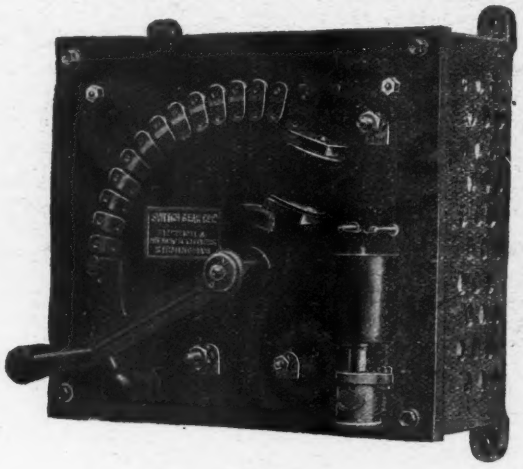


Fig. 3.

its winding in series with the shunt of the motor. No mechanical connections are needed to apply this time lag to an existing starter. Any competent wireman can connect it in a few minutes.

In a pamphlet recently issued by the Switchgear Co., Ltd., of Newhall Street, Birmingham, and written by their Mr. J. G. Statter, the subject of proper safety devices for the protection of continuous current motors and the use of the same is dealt with, and copies of this pamphlet and a number of their other publications can be obtained post free for 3d.

Lighting and Power Devices.

Messrs. Ward & Goldstone, of Dutton Street, Strangeways, Manchester, have recently issued a new supplementary list in which they set forth brief particulars, together with illustrations and prices, of a number of their supplies for electric lighting and power work. Among their new lines is the "Dutton" ironclad switch mounted on a varnished board with corner insulators and

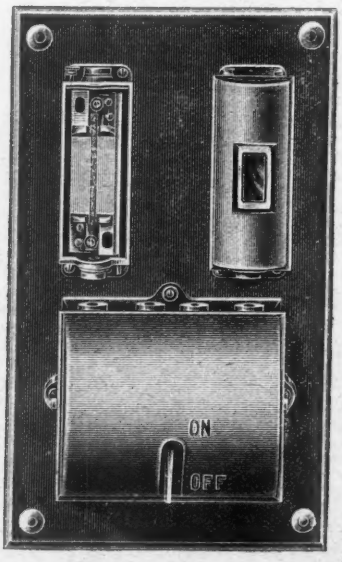
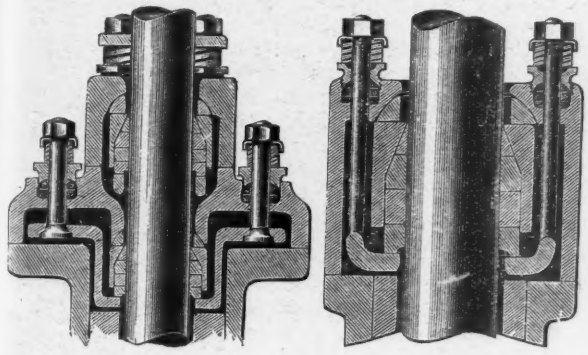


Fig. 4.

complete with D.P. ironclad fuses; this we show in figure 4. Other features are the "Vitro" fuse-box and replacement fuses, the "Challenge" iron fuse-boxes with asbestos lining, distribution fuseboards, heavy current-carrying distribution boards, the B type switches made for up to 300 volts, a number of types of lampholder devices and branch switches, wall plugs, water-tight fittings for factories, mills and collieries, and many small accessories.

New Patent Metallic Packing.

The accompanying figures show a new type of metallic packing which has been invented by Mr. Finlay McCulloch, of 273, Bury New Road, Higher Broughton, Manchester. The special feature of the device consists of the visible springs, which take up the wear of the metallic packing, and keep about 1½ lb. per sq. in. pressure on the piston rod; for condensing engines and pumps the pressure is about 1½ lb. above atmospheric pressure, to keep the vacuum. The working steam pressure feeds the packing automatically, but this pressure is only exerted on the rod during the single stroke, and, moreover, it is taken off the rod during the stroke in the same proportion as the steam pressure is reduced in the cylinder by its expansion after cut-off. The spring pressure can be adjusted and kept constant as wear occurs. The visible springs in connection with the packed bolts keep the vibrating cup against the ball joint; and the other end being free, the packing has perfect freedom to follow the movement of the rod. In some of the old forms of metallic packing with inside springs, when the latter break, great trouble is caused in renewing them through having to take out the packing; and when the inside springs have automatically to feed the packing there is a loss of power through the excessive pressure, which is greater than the highest steam pressure attained in the cylinder, being on the piston rod throughout the whole of the double-stroke. When this packing is used for pumps, the springs being outside and out of the way of the water, will not corrode or break through the solid pressure of the water. We understand that the device has been in use for some time with satisfactory results.



For high pressures. For low pressures.

Visible-spring Metallic Packing.

The Alleged Secret Syndicate in Germany.—The question of secret agreements between certain electrical firms in Germany is attracting some attention in regard to contracts thrown open to public tender in that country. According to a report of the proceedings at a recent meeting of the Dresden Town Council, an understanding or agreement was arrived at about the end of 1903, under which the prices for contracts of the value of over £1,000, and also the firm which should receive the order, were determined. The agreement was accentuated at the end of 1905, in such a manner as to include transactions of over £500, and at the same time it is stated that a contest with outsiders was to be commenced. During the discussion of the subject of contracts, it was asserted that apart from the so called secret electrical syndicate, a similar syndicate of a local character existed in Dresden, which was an organisation of firms which had made large increases in prices. The result of the discussion is that the submission of tenders will not be limited to local firms in the future. Simultaneously with the raising of the matter at Dresden, the question of the alleged secret syndicate has been given extraordinary publicity by the appearance of large advertisements in various daily newspapers in reference to a public competition for the supply to the electricity works of Frankfort-on-the-Main, of an alternating-current motor and two direct-current machines of a total of 300 H.P. It appears that five firms sent in tenders, and these may be set out under numbers, without giving the names, as follows:—

No. 1	£699	= 100 per cent.
No. 2	£1,135	= 163 „
No. 3	£1,160	= 167 „
No. 4	£1,210	= 174 „
No. 5	£1,215	= 175 „

The company which is referred to as No. 1 received the order, and the amounts of the tenders and percentages are given in the advertisements emanating from the same company. But the latter's statements are remarkable. The prices at which the contract has been awarded, the company states, are the present market prices, and these have been underbid by three of the other firms for the same and similar machinery in recent months. But in connection with the Frankfort competition, the four other firms, the successful company proceeds to allege, apparently believed that they alone were asked to tender, and they submitted prices designed to compensate for their former underbiddings. It will be interesting to see whether the firms concerned will take any notice of the publicity given to the Frankfort case, supposing that the figures already given are accurate. One of the Frankfort newspapers has published the names and prices in its news columns, and this fact should tend to evoke a reply from the electrical firms concerned.

THE L.C.C. POWER SCHEME.

A Private Enterprise Criticism.

Since the L.C.C. power supply proposals were made public several weeks ago, they have been subjected to severe criticism from many points of view. Indeed, in this present scheme, while trying to conciliate some former opponents, as ordered by the Select Parliamentary Committee, the promoters have succeeded in alienating the sympathies of others, and the long and short of the matter is that the proposal as already announced pleases nobody but those whose hydra-headed monster of an offspring it is.

The present majority on the Council wanted a new power scheme because London is not yet burdened heavily enough with indebtedness, and because the ratepayer does not know what to do with his money, his rates being so low. We do not doubt that, so far as a mere majority is concerned, the present Council would have voted in favour of any power Bill that its officers and advisers, including the Highways Committee, had thought fit to suggest, for the sound sense of the Finance Committee is not allowed to influence the consideration of this particular scheme. Mr. McKinnon Wood says that the Council had no alternative but to promote a scheme in order to defeat the private monopoly proposals. The question of possible profit or loss is to him a secondary consideration—if only he can kill private enterprise!

In view of the uncertainty that now prevails as to the actual details, it would be premature to discuss the matter very fully at present. But we have recently spent half-an-hour in conversation with one of the leading company supply authorities in London, and it may be useful to set forth below the criticisms that he personally offers to the project.

The first and foremost argument that is produced against the L.C.C. proposal is that it is not conceived in the interests of the ratepayers. Regarding the question of purchasing the Local Authorities' undertakings, it has to be remembered that some of these include plant which is practically antiquated; and a vast quantity of land, material, and stations which are not really required for the purpose of the scheme, if it is to be done in the most economical manner possible, will have to be bought up. In this way the Council will be burdened with an enormous dead load of capital upon its shoulders that it will not be able to make full use of, and the effect of this will be, directly or indirectly, to cast the burden upon the ratepayers (that is, supposing that the scheme cannot be carried on at a profit). If it should be carried on at a profit, then the users of power who are ratepayers will pay for the supply a higher rate than it would otherwise cost them, owing to the heavy capital charges.

It is contended that, all things considered, for the purposes for which the L.C.C. are likely to get any custom, the companies could supply it at as cheap a rate as the L.C.C., and quite as efficiently. The large individual power-supply, of which so much has been made, is held by the official interviewed to be a myth, and the actual power requirements of London, outside tramways and railways, will, it is believed, be found to be astonishingly small, having regard to the area proposed to be covered by the Bill. Our informant claims to speak with special knowledge on this particular point.

It is stated that it will be found, with perhaps the exception of some few districts in the East and in the South of London, that by far the greater proportion of the power used in areas is already supplied electrically by the companies at prices which are quite acceptable to the consumers, and compare very favourably with the proposed charges of the L.C.C.

So far as bulk supply to the companies is concerned, they, as a body, and in the majority of cases individually, could probably not afford to buy from the L.C.C. at its prices, and any less prices than their maximum would result in very serious loss for London. In looking to the companies as possible customers the L.C.C. is thought to be trusting to a very broken reed.

It must be borne in mind, as a generalisation, that in the total cost of cable hitherto half the cost has been with copper at about £56 per ton (the price of electrolytic copper is now £107 per ton), so that from the very start, in the very extensive distributing scheme which would be necessitated, the Council would be, in regard to the price of copper, at a disadvantage in capital expenditure on mains account to the tune of over 100 per cent. as compared with the price when the companies laid their mains.

So far as copper enters into the manufacture of electrical apparatus, as it does very largely, to that extent also will the increased capital cost be affected. One other point put forward was that in the event of the L.C.C. becoming purchasers of the local lighting authorities' undertakings, it would be quite open to them (as is now done by certain Borough Councils) to charge comparatively high prices for public lighting instead of cost price and show an apparent profit, whereas if cost price were charged a loss would be shown. There would, therefore, be a very large field for equalising losses at the expense of the ratepayers and the public lighting department.

In last year's Bill there was a clause enabling the Council to cross-charge to tramways and electricity accounts, leaving the door open for juggling the accounts of the two departments. A recent example of this kind of account-keeping is found in respect

to the Highways Improvements and Widenings, where, out of a total expenditure of £4,500,000, only £377,000 (a ridiculously inadequate figure) was placed to the debit of the tramways: a recent Progressive suggestion that the steamboats should be charged to tramways, and the whole treated as one account, is of the same order. Precisely the same sort of account-keeping could be effected under the clause referred to. It is also suggested that the L.C.C. is relieved of the necessity for an independent audit, a fact which might prevent the revelation of cross-charging and juggling if it occurred.

On the question of uniformity of supply and charging—the first point against this would be the fact that the Council would take over nearly 26 millions worth of plant, machinery and land, upon which alterations involving very great expenditure would be necessary to bring about anything approaching standardisation.

In regard to the estimated power demand in London, reckoning a 10-H.P. motor in a factory (250 8-C.P. lamps), 20 per cent. of this for lighting gives 50 lamps in a comparatively small factory, and the whole lighting supply of the consumer would be taken away from the distributor. It is very conceivable that lighting supply might not be entitled to earn such a reduced rate as would be given for power, and the addition in such a case would be a source of weakness to the revenue of the L.C.C. rather than a profit, while it would unnecessarily deprive the companies of a profitable lighting consumer.

With a private enterprise joint scheme it would undoubtedly be possible for the companies to devise some arrangement which would be more efficacious than the L.C.C. proposal. This would also save the ratepayers from the risk involved in an expenditure which must eventually approximate to between 30 and 40 millions.

It is quite improbable that the railway companies would take a supply from the L.C.C. Assume, for a moment, that the railway company took the supply of electric energy from the London County Council for suburban railway supply, the Council would put down the plant, provide the mains and probably the converting plant. A substantial interest in the railways would then have been created, and the next step would be an attempt to municipalise all suburban railways. Are the railway companies likely to play into the hands of the County Council in any such manner?

In regard to the clause "or at any time to purchase by agreement the whole or part of an undertaking," the effect of this might be that the Council might start out with the assertion that it did not intend to do the companies any harm. Parliament last year said that any measure which was brought forward should properly protect and conserve the interests of the existing authorised undertakings. Assume that the L.C.C., backed up by the power of the rates, purchased one or other of the undertakings at present competing in any particular area, the Council would immediately become a competitor of the non-purchased undertaking, and would be in a position to force that undertaking out of the field, or sell to it at an inadequate price—having completely spoiled its market value and destroyed its business, for there is nothing to prevent the County Council from supplying any particular district at a loss.

CORRESPONDENCE.

Letters received by us after* 5 p.m. on Tuesday *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Cost of Suction Gas Power.

I regret that I have been unable to reply sooner to the Campbell Gas Engine Co.'s criticism of my article on the above, but I have had no time to deal with the matter. It is a very easy matter for anyone to contradict the facts I gave; but before such contradiction holds good, I might inform the Campbell Gas Engine Co. that proof is required. The only proof the Campbell Gas Engine Co. have given confirms my figures in the majority of the items for works costs given by them in the REVIEW of November 30th, 1906. To prove this assertion, I have worked out their coal costs on the basis of 23s. per ton for gas and 6s. 6d. for steam :—

	Steam plant. Lighting load per unit generated.		Gas plant. Power load per unit generated.	
	No. 1.	No. 2.	No. 1.	No. 2.
Coal ...	·11d.	·157d.	·18d.	·224d.
Stores ...	·027d.	·027d.	·0704d.	·046d.
Wages ...	·12d.	·209d.	·12d.	·136d.
	·257d.	·393d.	·3704d.	·406d.
Repairs ...	.12d.	·207d.	·17d.	·176d.
	·377d.	·600d.	·5404d.	·582d.

Columns No. 1 are figures given in my article. Columns No. 2 are figures given for the Guernsey station, with coal items proportioned as mentioned above.

It is quite plain that the coal items are very similar, the difference for columns No. 1 and No. 2 for steam plant being ·047d., and for gas plant ·044d. per unit generated. It will be remembered that I distinctly mentioned in my article that allowance would have to be made for such a contingency, as I had based my figures on manufacturers' guarantees. The great point to note is that the proportion is the same. Regarding the item for stores, little need be said, except that under this heading I include water, waste, oil and sundries, put possibly the Campbell Gas Engine Co.'s figures do not include water. I only include water to summarise the item.

Under the heading of wages, the Guernsey plant works out at ·209d. per unit generated. This is excessive, and I should very much like to know how it was made up. If the Campbell Gas Engine Co. had any experience of this class of plant, they would know that it is ridiculous to put forward such a figure for the station I was considering. For their benefit, I might state that the figure I gave, viz., ·12d., was based on actual working experience of a similar station. The repairs item for the steam plant at Guernsey, ·207d. per unit, is also absurd, and I should think that part of the plant is obsolete.

I have looked up the pamphlet entitled "Gas Engines for Central Stations," by Mr. Hugh Campbell, and issued by his firm, and find that the steam plant consists of two 180-KW. sets and two 75-KW. sets, besides a battery of 32 KW., making the total capacity of the station 542 KW. The gas plant at Guernsey consists of two 180-KW. sets and a battery of 50 KW. giving a total capacity of 410 KW. The units generated by each station for quarter ending March, 1906, are practically the same, yet the steam plant is about 33⅓ per cent. larger. Further, it might be noted that this quarter is one of the best for a lighting station. To revert again to the item for repairs, would the Campbell Gas Engine Co. kindly inform readers, when each particular item of the steam plant was installed, and give similar information concerning the gas plant.

Little need be said regarding the figures I gave for the gas plant, as they compare favourably with actual working results.

With regard to the figures given by me for the calorific value of the anthracite, these were based on obtaining 79 cb. ft. of gas per lb. of fuel, the gas having a calorific value of 135 B.T.U. per cb. ft., and the efficiency of the producer being 85 per cent. If the Campbell Gas Engine Co. will work out this little sum for themselves, they will arrive at the same figure that I did. I should very much like to know what figures they would give, if they were asked for guarantees. Would they be so kind as to furnish this information without referring to text-books? I find that in the figures given for a six hours' trial run at Guernsey on September 20th, 1904, there were 123 cb. ft. of gas used per KW.-hour, the calorific value of 1 cb. ft. of gas in B.TH.U. being 151 gross and 143 net, and the approximate quantity of gas produced by 1 lb. of coal used in producer being 83, which gives the following results :—

Gross B.T.U. per lb. of coal = 151 × 83 = 12,533.

Net " " " = 143 × 83 = 11,869.

These figures are conclusive evidence that the figures given by manufacturers are not obtained in practice, and that I was correct in making the allowance I did.

Another point to which I would draw attention, is the fact that if the calorific value of the fuel is more than I allowed, then for a given efficiency of producer, the calorific value per cubic foot of gas should be proportionately increased, and, therefore, the gas engine should require less cubic feet of gas for a given output. I think this simple statement should be clear to everyone.

With regard to the figures for capital cost which they give for Guernsey, these are no criterion of what such plant would cost at the present time, but it may be of interest to the Campbell Gas Engine Co. to know that the figures given by me for both the steam and gas plants, are actual costs based on competitive tenders, and are an average of what the plants could be put down for in this country.

In conclusion, I wish to inform the Campbell Gas Engine Co. that I am *not* interested in either type of plant, and my views are quite unprejudiced, and it ill becomes a firm to

make this accusation, when everybody is fully aware that they must be prejudiced themselves. Further, might I advise them that it would be advisable in future not to presume to criticise an article, which, by their own admission, they have not taken the trouble to read, and part of which (such as the steam portion) they have not the necessary information to deal effectively with. If they are in a position to do so, I challenge them to give a detailed statement of the capital cost of the steam generating plant I considered in my article.

Ipso Facto.

Patents and Prejudice.

As a constant reader, though now a Canadian, will you allow me to reply to your correspondents, Mr. Swinburne and "Statistics." This old fallacy that imports must be paid for by exports is always cropping up, and it did so in the *Bradford Observer* during the last general election. After depositing £10 with the *Bradford Argus*, I challenged the writer of the article in question to show that this statement was sound political economy; the reply was that it was not, but that it was near it; to my reply showing that it was not even near it there was no answer.

Adam Smith says what is true of an individual cannot fail to be true of a nation. If, therefore, a nation's imports exceed its exports, it shows that the nation has purchasing power outside its producing power, in exactly the same way that an individual who has money can purchase without producing. And just as the individual may be either spending the interest of his capital, or encroaching on it, so may the nation. In the same way as the individual may render services other than producing, so may the nation, and get pay in return, *i.e.*, "purchasing power." Free imports have the effect of making everything cheap, and as every article is really so much labour (Adam Smith's "Wealth of Nations"), labour is the first thing it cheapens. As a natural consequence, a man with money to spend can get more labour in return for it, all other things being equal, in a free import country, than he can in a protected country, and the converse also holds true, the man with labour to give can get less in return.

W. Todd.

Toronto, *December 2nd*, 1906.

Cost of Living in Brazil.

The letter of "English" in your issue of October 26th forcibly reminded me of my difficulty in obtaining any information about the country before coming to Brazil (S. Paulo) 30 years ago. I therefore have much pleasure in acceeding to your request in the footnote to "English's" communication.

Brazil is an immense country, so that what applies to one portion is not necessarily correct for another. In the States of Rio de Janeiro, San Paulo, Minus Geraesda, the costs are more or less as follows. As a rule, a young man would live and board at an hotel, which would cost him, everything included (except drinks), from £9 to £15 a month. Washing would cost 4s. to 5s. per dozen pieces. German beer made in the country, 1s. 4d. to 2s. a bottle. Table wine about 3s. a bottle. Brandy, &c., about 1s. a small glass. A bottle of Martell's three-star brandy costs 13s. Draught beer is now to be found in most towns at about 6d. a glass. Good cigars can be purchased at about 8d. each, and good, pure tobacco, grown in the country, for 5s. a pound. Boots cost about £1 to £1 10s. a pair, and a suit of clothes from £7 to £10.

On the whole, a single man could make a fair start on Rs.500,000, or, say, at the present rate of exchange, £34 a month. He would not save much out of this, but could get along fairly well.

A married man would have to double this, and he could not live decently for less. He could not expect to save much out of a salary of £800 per annum.

A small house will cost about £16 a month, and servants cost from £3 5s. to £5 a month each.

In the States mentioned, the usual clothes worn in England are required, but with a large average of light summer garments. Serge is an excellent material. As a rule, a good stock of clothing is brought out from England, and this is renewed during the usual trips home.

Portuguese is entirely spoken all over Brazil, but the language is easily picked up in a few months, sufficient for all practical purposes.

In the North, about the Amazon-Manaus, the figures given above would probably have to be doubled.

I have written the above, having in view the young electrical engineer, or in the case of a married man, that of a chief engineer. Fitters and mechanics, and I have known many, all do exceedingly well on lower salaries, and save money. They, however, come out, as a rule, engaged for railway companies, which, in many cases, furnish houses at nominal rents to their employés, and provide water, old sleepers for fuel, passes on the railway, &c. As a rule, also, a mechanic's wife takes sole charge of his house, thus avoiding the costly luxury of highly-paid servants.

A word of warning. I should strongly recommend anyone thinking of coming out, only to do so when he has a berth to come to, and by no means to come "on spec." Also the general question should be carefully considered as to whether it is not more advisable to emigrate to a British possession than to go to a foreign country where naturally anything good is given in preference to the natives. Brazilian engineers are numerous and clever.

Another Englishman.

S. Paulo, *November 20th*, 1906.

Rail Corrugation.

It is gratifying to note that Messrs. Yerbury and Thom, who have had a wide and extensive experience of corrugation evils, endorse my suggested remedy for their prevention, viz., "prolonged rolling at low temperatures." I consider Mr. Yerbury's suggestion of "annealing," will also prove of advantage, and agree with Mr. Thom's idea of a finishing roll after annealing, so as to induce the essential physical condition of a "homogeneous molecular structure," which I have, from the first, consistently advocated as an imperative condition. I dealt rather exhaustively with the subject of tramway rails in *Electricity*, May 20th and 27th, June 3rd and 10th, 1904, which article at this opportune moment I consider worthy of perusal. In it I show fully how both "chemical composition" and "mechanical treatment" affect a rail. It is, however, needless to dwell on this, but I may state that the essential to bring about a "homogeneous structure" is prolonged rolling.

I think we now have a practical basis upon which to form a preventative for future rails (defective in workmanship) being installed, providing, of course, a suitable rail specification and vigilant inspection during manufacture, &c., are insisted upon. A great deal now depends upon consultants or engineers who plan the specification, and also the people who let the contracts; as no contract should be let to any firm or manufacturer who will not guarantee to supply a rail, which will not develop corrugations, *i.e.*, if properly installed. Neglecting the essentials relating to chemical composition, &c., the reliability of a rail centres around what is physically represented by the word "homogeneity." The progress made during the past few weeks has been encouraging and somewhat conclusive. This is satisfactory so far as it goes, but what of the many tramways who have installed thousands of tons of these rails lacking in homogeneity. I believe I can suggest a remedy, the value of which consists in its simplicity and practicability, it being a comparison of the effects of everyday practice on the same rail after being subjected to re-rolling. My idea is for one or more Corporations to take up one or several lengths of badly corrugated rails, and in their place install a new one, then to forward these defective corrugated rails to a firm to be re-heated and re-rolled, and treated on the lines suggested by Messrs. Yerbury, Thom and myself; and I think that the rails should be rolled through "slow-running mills." On looking over my notes, I find that the York Transverse Rolling Process Co., Ltd., Dock House, Billiter Street, London, E.C., make a speciality of re-rolling steel rails, and they might guarantee to execute a satisfactory job. After re-rolling, the rails should be re-installed in exactly the same position that

they previously occupied when corrugations developed. The rail should then be carefully watched for any signs of corrugations, and any statistics recorded appertaining to time intervals as regards corrugation developments (either on new rails or re-rolled rails, if they occur) should prove of value. If corrugations did not again develop on re-rolled rails, it would conclusively prove that the fundamental cause is lack of workmanship or mechanical treatment. In my opinion, a very stringent specification for rails will, in the future, have to be insisted upon, especially in regard to mechanical treatment, and facilities afforded for inspection during manufacture by a thoroughly competent practical experienced engineer. Of course, it should be recognised that if one desires a high-class rail, they will have to pay a fair price for it, and rail purchasers must not place British rail manufacturers of high standing, who are prepared to fulfil all essential requirements to supply a high-class rail, in competition with Continental manufacturers or suppliers of scrap, whom, I contend, have only shaped the heated metal into the form of a rail; and as previously stated (Review, July 27th, 1906) I believe that prolonged rolling is dodged, for time and power (the workmanship or mechanical treatment depends upon these two factors) represent money. I consider that several corporation tramways in Great Britain have been the scrap heap for foreign-made rails, and that the primary cause of rail corrugations is keen competition. Finally, if corporations or companies wish for a high-class rail, they must specify accordingly and pay the price. You cannot expect to get a high-class guaranteed rail at £6 per ton; £8 per ton is nearer the price, and at that figure rails will prove much cheaper in the end. In the Review of July 27th, I stated that rail grinding would not permanently remove corrugations, and I repeat the statement. For defective rails the only remedy to my mind is re-rolling or scrapping; and, in conclusion, I may say that I think there is an extensive field for a reliable firm who are capable of re-rolling rails, and inducing the essential condition of "homogeneous molecular structure," especially if the cost is reasonable.

Wm. R. Bowker.

Manchester, *December 14th*, 1906.

Compensation for Armature Reaction.

My attention has been called to an article in your issue of November 23rd entitled "Direct Compensation for Armature Reaction in Alternators," by Alexander Heyland; abstracted, I think, from the *Elektrotechnische Zeitschrift*.

In this article Mr. Heyland lays claim to a new method of compensation for armature reaction in alternators, which consists in simply using the alternator leakage field (which varies with the armature reaction) to alter the exciting voltage automatically.

I wish to say that this principle was embodied in alternators designed by me two years ago, and that scores of such machines are now in use.

The full details of my arrangement are embodied in the paper to be read before the Manchester Section of the I.E.E. on January 8th, 1907, when it will be seen that though I was, I think, the first to make use of the principle, the method of application differs considerably from that adopted by Mr. Heyland.

William Cramp.

Manchester, *December 17th*, 1906.

The Wireless Telegraph Conference.

Mr. Cuthbert Hall is doing a public service by enabling me once more to state the facts, which, instead of disproving, he simply meets by a personal denial. Anybody can deny an awkward fact; but that does not get rid of the fact. I have asserted—and my assertion would not have been made had it not been confirmed by inquiry of a person in authority in the Admiralty—that the only Marconi apparatus which, under its agreement with the Marconi Co., the Admiralty is compelled to purchase from the company consists of jiggers and Leyden jars. Mr. Cuthbert Hall simply denies the statement.

Well, anybody can purchase for the sum of one penny the official publication "Cd. 3,047. Agreement between the Admiralty and the Marconi Wireless Telegraph Co., dated the 24th July, 1903." On page 5 of this agreement stand the plain words:—"The Commissioners (*i.e.*, the Admiralty) shall at all times be at liberty to obtain from other sources (that is, other sources than the Marconi Co.) such apparatus used for wireless telegraphy as is not enumerated in the schedule referred to." The following is the entire schedule:—

Short wave.—Transmitting jigger No. 5...	£5	1	6
Condenser for same (tray of six Leyden jars) ...	6	4	0
Receiving jigger No. 306	0	10	9
Long wave.—Transmitting jigger No. 17	4	14	0
Condenser for same (tray of 15 Leyden jars) ...	14	10	0
Receiving jigger No. 343	0	17	0

I hereby defy Mr. Cuthbert Hall to assert that there is any other apparatus mentioned in the schedule than jiggers and jars. It does not require counsel's opinion to determine the fact.

I have an equally good answer to make to Mr. Cuthbert Hall as to the other agreement with the Post Office, which he has repudiated. But before going one inch further, I await his admission of my present substantiation of the facts.

Your Correspondent.

Tantalum Lamps.

We have seen in your "Correspondence" columns various letters as to the merits and demerits of various lamps, and we should like to see other contractors' experiences with these lamps.

We know they are not satisfactory on alternating currents, also where the lamps are removed nightly from outside fittings, &c., probably on account of the polarity being changed.

For ordinary series lighting we are finding these lamps anything but reliable, and as the voltage on actual tests is the same as the rating of the lamps, over-running cannot be the cause of failure.

Once during a breakdown, when the voltage was about a third of the normal, the ordinary carbon filament lamp gave no light, while the Tantalum seemed to be particularly brilliant.

Is the Tantalum lamp simply an over-run one, or is it all the makers claim for it?

Tantalised.

The Conduit Trust.

Referring to a letter which appeared in your issue of December 14th, I enclose two cuttings taken from The *North Mail*, which show that we up in the North, at all events, are fully alive to the dangers to contractors and others from anything in the nature of a combine; perhaps the publication of these may stir others up.

Electrician.

December 17th, 1906.

[It is stated in the cuttings that the users of conduits are displaying hostility to the "trust." The statement comes from the representative of one of the firms that have remained outside.—Eds. E.R.]

The Electrical Trades Benevolent Institution.

The above Institution is now actively at work, and thanks to the success of the Olympia Electrical Exhibition and the activity of its Committee, has a considerable sum of money to its credit. Unfortunately, an Institution that is benevolent must continually be seeking the wherewithal to support its benevolence, and for this reason I venture to ask you for space in your esteemed journal to bring the matter before your readers at a season when donations and subscriptions should easily be forthcoming. Should the methods or objects of the Institution be unknown to anyone, a letter to the secretary at Dartmouth House, Queen Anne's Gate, will secure full information; and all contributions addressed in the same manner will be promptly acknowledged.

One of the Committee.

The Social Side of the I.E.E.

I wish to endorse all that your correspondent, Mr. C. S. Northcote, says with regard to the above subject, in your issue of the 21st inst.

I have often thought that it would be most desirable to have an Electrical Club, especially as the Institution has at present no building of its own, although its funds for the same are apparently quite considerable.

D. R. Broadbent.

London, *December 22nd*, 1906.

BUSINESS NOTES.

Insurance of Marylebone Plant.—The following quotations were received for the insurance of the Marylebone Council's electrical plant against breakdown to the value of £17,050:—

Law Accident Insurance Society (accepted), annual premium £500.
British Engine, Boiler and Electrical Insurance Co., Ltd., £1,171 14s. 6d.
National Boiler and General Insurance Co., Ltd., £1,171 14s. 6d.
Vulcan Boiler and General Insurance Co., Ltd., £1,152 4s. 6d.

The Council will carry out the repairs to the plant, either through its own workmen, or through the makers of the plant, or other approved firms, the Insurance Society bearing the cost. The Society undertake the insurance for three years, and will grant a rebate when the claims do not exceed 20 per cent. of the total premium, of 15 per cent. on the gross premium, or alternately of 20 per cent. on the difference between the claims and the gross premium.

Enterprise in Advertising.—THE LINOLITE CO. have just introduced a novel advertisement for their goods. An evening delivery van (horse) is fitted on either side with suitable notices referring to their goods, and with two samples of picture lighting on the back. The notices are lighted by lengths of Linolite, and along the top of the van the word "Linolite" is constructed of the actual article. The whole is run on a 110-volt circuit by means of a small petrol motor direct coupled to a 3-H.P. dynamo. The van started on 18th inst., and will continue to deliver goods *viâ* the principal thoroughfares of the metropolis during the evenings of the next few weeks.

British Motor-Cars for France.—We are informed that a prominent French manufacturer of motor-cars bought an "Adams-Hewitt" light car for his own use at the late show at Olympia, upon the understanding that if the car proved satisfactory he would purchase eight more for selling purposes, as he manufactured heavy cars only. We now learn that an order for the remaining eight has just been received by the ADAMS MANUFACTURING CO., LTD. It is regarded as a triumph, not only to send light cars into the very home and stronghold of small cars, but to have them selected by a French manufacturer himself.

Consular Notes.—ARGENTINA.—The Austrian Consul at Buenos Ayres in a recent report states that the increased importation of electrical goods in 1905 was due chiefly to the extension of the tramway system of Buenos Ayres, and in a lesser degree to the adoption of electric lighting all over the country. Small quantities of insulating materials, carbons, wire and cables, arc and incandescent lamps, were imported from Austria. Competition is by no means easy, particularly with German goods, which have secured a predominant position in the Argentine market.

RUSSIA.—The Austrian Consul at Warsaw reports that the year 1905 was of no very great importance for the electro-technical trade, as, in consequence of the general crisis, imports were very limited and prices very low, although the Russian electrical works, notably the Russische Allgemeine Elektrizitats Gesellschaft, of Riga, Siemens & Halske, of St. Petersburg, Zentral Elektrizitats Gesellschaft, of Moscow, and the Aktiengesellschaft Volta, of Reval, through lack of work lessened competition considerably. Small armatures and parts for electrical installations, which are not produced in Russia in any great quantity, were imported chiefly from Germany. The new Customs tariff almost eliminates the demand for foreign dynamo machines and electric motors, and the Russian industry has expanded to such an extent that it is now able to supply the demands of the whole country; small electromotors which are manufactured abroad very cheaply, are still able to compete with moderate success. A demand still exists for arc lamps and incandescent lamps; these goods were formerly not manufactured in the country, and are now only produced in insufficient quantities. Carbons were imported from abroad only in very small quantities, and importation will probably cease, owing to the increased duties; several establishments for the production of these goods have recently sprung up in Russia. The importation of steam machines was, owing to lack of demand, very unimportant in 1905. In spite of the increased duty, the importation of machines of precision will still be possible, as Russia and Polish machine works are not able to produce this class of goods. Steam boilers of foreign origin have already been ousted from the market almost entirely. The trade in motors was very active in 1905, the goods in special demand being gas and suction gas motors, and petroleum motors. Germany supplied 50 per cent. of the imports, and the United Kingdom and Switzerland 20 per cent. each.

Japan.—The Austrian Consul at Yokohama in a recent report, states the imports of electric motors are increasing from year to year. The figures are as follows for the last five years:—1901, 388,000 yen; 1902, 810,000 yen; 1903, 836,000 yen; 1904, 1,266,000 yen; and 1905, 2,455,000 yen. Importation is likely to increase still further in future years, as cheap coal and water power are very plentiful.

SANTO DOMINGO.—In a recent report the French Consul at Santo Domingo, gives the following figures showing the importation into that country of electrical and other goods in 1905:—

	Lb.	Dollars.
Copper and Articles of Copper—		
From United States	14,528	2,595
Germany	5,706	1,369
Other countries	4,041	441
Total	24,275	4,405
		Dollars.
Electrical Apparatus—		
From United States		151
Germany		25
Belgium		10
Total		186
Locomotives and Accessories—		
From United States		29,386
Great Britain		1,185
Germany		1,629
France		30
Total		32,230
Electric Machinery—		
From United States		16
Rails—		
From United States		6,261
Germany		156
Great Britain		23,760
Total		30,177
Electric Lamps—		
From United States		102

Electro-Therapeutic Exhibition.—On Friday the 14th inst., there was held at the Queen's Hall, Langham Place, the third annual Exhibition of the Electro-Therapeutic Society, which was again a great success, being well patronised by the medical profession and members of the Society, besides a good number of those interested in the practice of electro-therapeutics from the various London and provincial hospitals. A large collection of electrical apparatus used in the science was shown, and the latest pattern instruments were in operation. Among those exhibiting may be mentioned: Harry W. Cox, Ltd., Rosebery Avenue; Sanitas Electrical Co., Ltd., New Cavendish Street; Watson & Sons, High Holborn; Newton & Co., Fleet Street; W. Schall, New Cavendish Street; and Krupka & Jacoby, of 61-2, Watling Street.

The last-named firm are the sole British representatives of the United Electro-Technical Institutes Frankfurt and Aschaffenburg, and their exhibit included the Multiplex, a universal apparatus for connection to continuous-current mains up to 250 volts, for use in all branches of electro-therapeutics. It consists in a square pedestal supporting a motor converter and having on three sides switch panels with the necessary instruments, resistances, &c. They also showed the Tremolo, a vibratory massage apparatus for attachment to an electro-motor, having the means of regulating the rapidity of vibration while in use; universal wall set complete with X-ray coil and switch table with ammeter, pilot lamp, regulating and controlling switches, for use in dark room for X-ray work, radio-photography, &c.; induction coil (16 in. spark) Dessauer's system, a very compact and conveniently designed coil having specially strong primary winding for use with electrolytic or motor interrupter, specially designed for taking radiographs and examination with compressor and anti-compressor diaphragms; L'Energique (patent) a new form of secondary battery or accumulator, recently described in our pages; and Tantalum lamps.

Steel Trade Activity.—Steel prices have not been o high for seven years, and a further almost continuous increase is looked for next year. Steelmasters have orders booked that will keep them busy for six months, and are now actually offering contracts to rival firms. Unless more raw steel supplies are forthcoming it is feared that many of the sheet rolling mills must be stopped.—*Standard.*

Electric Incubator.—Dr. Weaver, the Medical Officer of Health for the borough of Southport, has applied for a patent for an electrical incubator which he has invented. The incubator is heated by means of electric radiators and provided with a thermostat-like apparatus for throwing some of the radiators into

and out of circuit, so as to regulate the temperature. In one form of the incubator a maximum and minimum thermometer is placed inside the incubator, and contacts are provided, and the circuits arranged so as to throw the radiator into and out of circuit as the temperature reaches its lower and higher limits respectively. The incubator can be lighted up at will, and through a small window the eggs may be examined at any moment without opening the drawer. The invention has already been successfully used for the incubation of chickens, ducks and geese. The apparatus is absolutely automatic, and the temperature can be fixed according to requirements.

Book Notices.—"The Practical Electrician's Pocket Book for 1907." Edited by H. T. Crewe. London: S. Rentell and Co., Ltd. 1s. net.

"The Physical Review." Vol. XXIII, No. 6. December, 1906. London and Lancaster, Pa.: The Macmillan Co.

"Fire Tests with Doors." "Red Book," No. 117 of the British Fire Prevention Committee. London: The Committee. 2s. 6d.

"Modern Buildings: Their Planning, Construction and Equipment." By G. A. T. Middleton. Vol. V. London: The Caxton Publishing Co. 1907. 10s. 6d. net.

"Proceedings of the American Society of Mechanical Engineers." Vol. XXVIII, No. 4. December, 1906. Baltimore, Md: The Society.

Trade Announcements.—The British Thomson-Houston Co., Ltd., notify that on and after January 1st, 1907, their Belfast branch office will be closed. All communications from that district should be addressed to either their head office and works, Rugby, or to the Glasgow branch office, at 91, Wellington Street.

Messrs. Bruce Peebles & Co., Ltd., announce that their works will be closed from Monday, December 31st, to the following Monday, January 7th. Goods will neither be received nor dispatched during that period.

Messrs. Henley's (South Africa) Telegraph Works Co., Ltd., of 1 and 3, Chorlton Chambers, Harrison Street, Johannesburg, have removed to Howard Buildings, corner of Loveday and Main Streets, Johannesburg.

Messrs. R. W. Vicarey, Ltd., accumulator experts, wish it to be known that their only address is now Black Hill, Clun, Salop, where all communications should in future be sent.

Messrs. Newtons, Ltd., notify that their works are closed until Monday next, December 31st, for holidays and stocktaking.

We understand that the business of the Telephone and Electrical Installation Co., electrical engineers, contractors and telephone experts, together with that of Messrs. Horace Simon & Co., electrical engineers, of 2, Mincing Lane, E.C., have been acquired by Electrical Installations, Ltd., whose registered offices are at 11, Queen Victoria Street, E.C. The first annual dinner of the new concern was held on Saturday, the 15th inst., at the Windmill, Cannon Street, Mr. Horatio Bell, director, in the chair. There were also present Mr. Horace Simon and Mr. Stanley C. Russ, directors, together with a number of guests. A most enjoyable evening was spent.

Messrs. A. Reyrolle & Co., Ltd, Newcastle-on-Tyne, announce the closing of their works from Monday last to Wednesday morning next, January 2nd, for the holidays.

Catalogues, Calendars and Lists.—"Thermit" electric welding will be kept in many a mind during some months of the year 1907 by means of a very handy pocket-book that Messrs. Thermit, Ltd., have issued. Useful general information regarding their system occupies the first few pages, and then follow a couple of pages with calendars for 1907 and 1908—the compilers are wise to include the latter. The remainder is a notebook, on the refill principle, purely for general memoranda purposes—it is not a diary.

From Messrs. W. T. Henley's Telegraph Works Co., Ltd., we have received a wall calendar on the perpetual card-changing principle. In the general design of the card a special feature is made of a photographic view showing a bay at the new works of the company at Gravesend.

Messrs. W. T. Glover & Co., Ltd., of Trafford Park, have, as usual, made preparation for the daily edification of electrical men during the new year. It takes very much the same form as in previous years—daily slips with interesting contributions, sometimes humorous and original, and sometimes serious extracts from speeches or papers delivered or read by electrical engineers. Cartoons abound, and there are also photographic illustrations showing cable-laying operations and manufactures of the firm. The block of slips is wired on to a stout card which represents a side and top view of a cable drum. The production of this almanac must have involved a great deal of compilation work and editorial supervision in the selection of suitable material, but we have no doubt that the firm finds itself well repaid for the cost and trouble by the knowledge that both technical and commercial electrical men appreciate it and find it of service. This is the fifth year of issue, but the present almanac only covers the period until June next, after which it is intended to issue them in midsummer for the full 12 months. On the back of the card a good deal of data is given which has been specially compiled for use in connection with electrical distribution.

Messrs. Clarke, Chapman & Co., Ltd., have favoured us with one of their useful Pocket Diaries for 1907, with the customary insurance coupon. The first few pages contain illustrated information concerning the company's manufactures, and the addresses of its different branches at home and abroad, also a good deal of useful general information.

The 1907 diary and pocket-book received from Messrs. Simplex Conduits, Ltd., is neater than a good many we have seen, and its black cover with gilt lettering makes it the sort of thing that no one need be ashamed to have in daily use. Suitable information concerning Simplex material and prices of same quite fittingly occupy the first two dozen pages. In the rest of the book alternate pages are occupied with diary spaces, the facing pages being left available for general memoranda—a very good idea we think; squared paper is used throughout. An accident insurance coupon is, of course, included.

The Electrical Power Storage Co., Ltd., of Great Winchester Street, E.C. It would be a strange Christmas that did not bring with it the office blotting pad from this company. In the diary, which as usual is fixed on the left-hand side of the pad, there is also given a good deal of useful general postal information and data concerning E.P.S. batteries. Monthly date-cards are placed at the top edge of the pad, and, of course, there is the customary insurance policy. This year the cover of the diary is attractively coloured. The E.P.S. contribution to office requisites is always acceptable.

Titan Packing Co., Tower Royal, E.C. Circulars relating to their black and red "Solvis" jointing, and Titan asbestos packings.

Messrs. F. Darton & Co., St. John Street, E.C.—Catalogue (48 pp. illustrated) showing a big variety of electrical novelties suitable for Christmas and New Year presents.

Messrs. Crosier, Stephens & Co., of Newcastle-on-Tyne, have wished us and their friends the Season's Compliments, and accompany the wish with a neat little ash tray, which, other things enabling, will render useful service in this office for some little time to come.

From Messrs. Johnson & Phillips we have received a convenient and extremely neat pocket diary and engagement book for 1907. It is just the size to fit into one's vest pocket and keep as a constant companion.

Once again we are favoured by the Hart Accumulator Co., Ltd., of Stratford, with a useful blotting pad with top pocket.

Messrs. Gent & Co., of Leicester, will keep their name and specialities before the trade during 1907, by means of a calendar, made up of weekly slips, each taking the form of a bell-indicator face to "indicate" the dates.

A Christmas souvenir from the Allgemeine Elektricitats-Gesellschaft (Foreign Department) takes the acceptable form of a weighing balance for office use recording up to 75 grammes.

For Sale.—The Great North of Scotland Railway Co is offering for sale certain second-hand engines, dynamos, &c., for electric lighting. See our advertisement pages to-day.

On Tuesday, January 8th, Messrs. Percy Huddleston & Co. will offer for sale by auction at West Norwood, a complete gas-driven electrical installation which Messrs. Carl Hentschel are disposing of in consequence of their premises now being connected to the public mains. See our advertisement pages for particulars.

Brush Employés Hospital Fund.—The employés of the Brush Electrical Engineering Co. have contributed £200 to the funds of Loughborough Hospital.

Dissolutions and Liquidations.—Cape Town Consolidated Tramways and Land Co., Ltd.—A meeting will be held at 1, London Wall Buildings, E.C., on January 22nd, to hear an account of the winding up by the liquidator.

With reference to the notice in our last issue regarding the dissolution of partnership between Mr. Edward Steinthal and Mr. W. P. Steinthal, the latter gentleman asks us to state that he is continuing the business without alteration of name, at 41, Piccadilly, Bradford, and at 18, Cooper Street, Manchester.

Bankruptcy Proceedings.—C. V. T. de Falbe (Electrical and General Contracting Co., Shaftesbury Avenue, W.C.)—Second and final dividend of 9s. in the £ payable December 29th, at the offices of Messrs. Poppleton & Appleby, 3, Barbican, E.C.

LIGHTING and POWER NOTES.

Coventry.—It was reported on Tuesday last week that the town clerk had received the sanction of the L.G.B. to the borrowing of the sum of £31,499 (on account of the application for £37,432) the balance of the application—£5,933—being deductions made by the board as follows: £5,338 in respect of old and disused plant (£2,886 of which was written off last year out of profits, and the remainder, £2,452, will be written off out of future profits); £500 over-estimated for cost of reinstatement of trenches after the laying of spare pipes for cables, and £95 in respect of a sinking fund payment, which would have been made if the loan had been sanctioned prior to incurring the expenditure on the new water purifier.

Newark.—The T.C. last week held a special meeting to pass a draft memorial to the B. of T. for a prov. order amending the Newark E.L. Order, 1900; under the old order the Council had no power to transfer the execution of the order of the company, and the memorial asked the board to give that power. The present order expires in March next, and the application proposes to extend the time by 18 months.

(*Continued on page* 1039.)

THE MANUFACTURE OF ELECTRIC CONDUITS.

THE PERFECTA WORKS AT BIRMINGHAM.

On the occasion of one of our recent editorial visits to the provinces we spent several interesting hours at the works of the Perfecta Seamless Steel Tube and Conduit Co., Ltd., in Plume Street, Birmingham.

There are altogether some ten or twelve firms in the whole of the United Kingdom which make a speciality of conduit manufacture for electrical installation purposes, and, according to reports, all save two of these have arrived at a common understanding with a view to the maintenance of better prices than have hitherto been obtained. We know little of this arrangement beyond the fact that it has been reported in the provincial papers that it exists, and that circulars were recently sent out by the firms interested intimating an advance of, it is said, 8 to 22 per cent. on former prices. Of the two firms said to stand outside this co-operative arrangement one is the Perfecta Seamless Co. We have already given an illustrated account of the various departments of another conduit firm in Birmingham whose works exist solely for the manufacture of this class of material. The Perfecta Works, on the other hand, have been established for many years for the production of steel tubes for boiler and other purposes, and it is only during the last four years that they have been engaged developing their electric conduit business.

When this department was commenced, there was just sufficient land available for the erection of the necessary buildings, so that now, when reasonable allowance is made for yard room, the entire site (three acres of freehold land) is covered with factories in which between 400 and 500 men are employed. All the buildings are equipped to their utmost capacity with the latest machinery.

Fig. 1.—Corner of Rolling Mill.

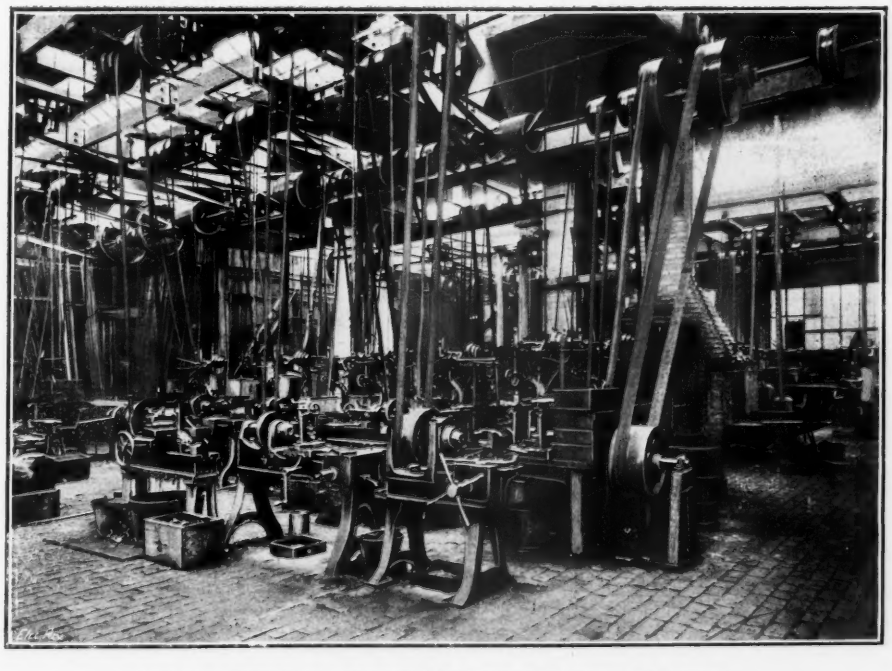


Fig. 2.—Portion of Screwing Department: Conduit Department.

The general processes involved in dealing with the metal, from its receipt in billet form to its arrival at a degree of fitness for being dealt with in the conduit shop, are of interest to the general engineer rather than to the electrical, but we have given several views to indicate roughly the various stages of manufacture through which the metal passes, and we think that these will serve to impress our readers with the large and varied extent of the company's operations. The company are manufacturers of every class of solid-drawn steel tubes, from steam pipes 10 in. diameter × $\frac{3}{4}$ in thick, for battleships, down to $\frac{1}{4}$ in. or $\frac{3}{16}$ in. diameter × 20/22 gauge tubes for the brake rods of bicycles; between these two extremes they manufacture tubes for every engineering pur-

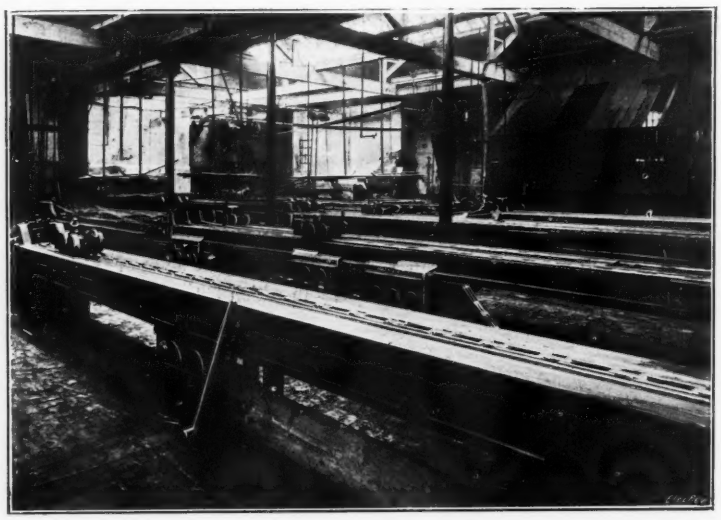


Fig. 3.—One of the Seamless Conduit Cold-Drawing Departments.

by which this is manufactured into tube and eventually finished by cold-drawing. One of these presses alone will exert a pressure of 1,000 tons, and will pierce a 6-in. or 8-in. hole through one of these solid billets in a single operation lasting a few seconds. In this section of the mill are machines, which we illustrate, for the hot-rolling and drawing of every size of tube.

It is in this mill that the solid-drawn seamless steel tubing for the electrical conduit is made from the original steel billet. The process of cold-drawing, which we show in one of the photographs, is very interesting.

The rough rolled tubing is carefully annealed and then pickled to remove all trace of scale, leaving it with a comparatively smooth surface, and after washing and oiling is cold-drawn through steel dies over a mandrel inside. This process considerably thins the walls of the tube, solidifies the material, and after frequent repetition produces a practically smooth surface on the tubes both inside

Fig 4.—Stocks of Solid Billets for Seamless Conduit.

Fig. 5.—Conduit Warehouse.

pose, for water-tube boilers of the Thorneycroft, Belleville, Durr, Yarrow, &c., types, for portable boilers, hollow shafting, steam economisers, &c. A separate department is occupied exclusively in the manufacture of cycle tubes and in the bending of the accessories such as handle bars, stays, &c.

On entering the yard one forms an idea of the large power required for dealing with the material necessary for the manufacture of solid-drawn tubes. The material in question consists of stacks of billets, 10 in. and 12 in. diameter, 2 ft. to 3 ft. long, weighing several cwts. each, and we were shown the hydraulic machinery

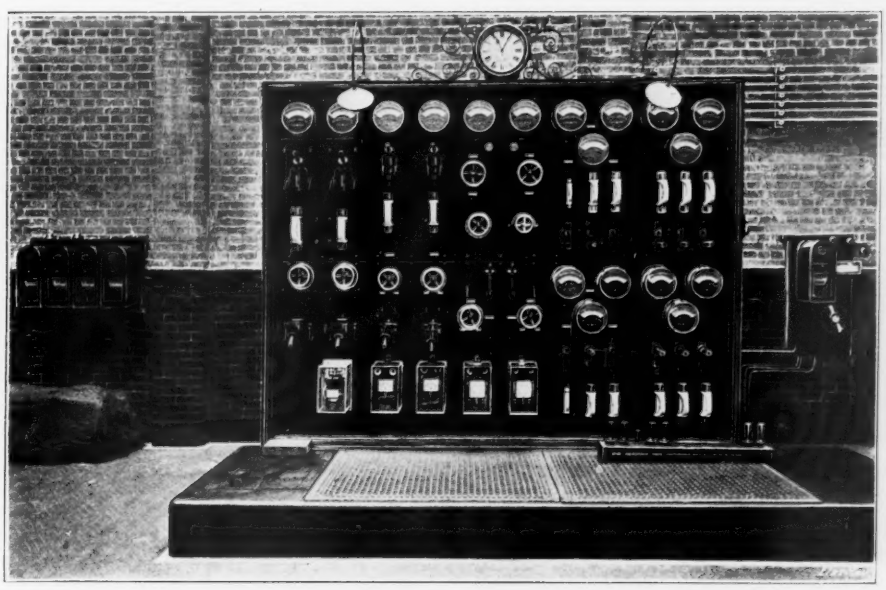
Fig. 6.—Conduit Boring and Fitting Shop.

and out. After final annealing the tubes are ready for sending to the conduit department for screwing, socketting, enamelling, or galvanising.

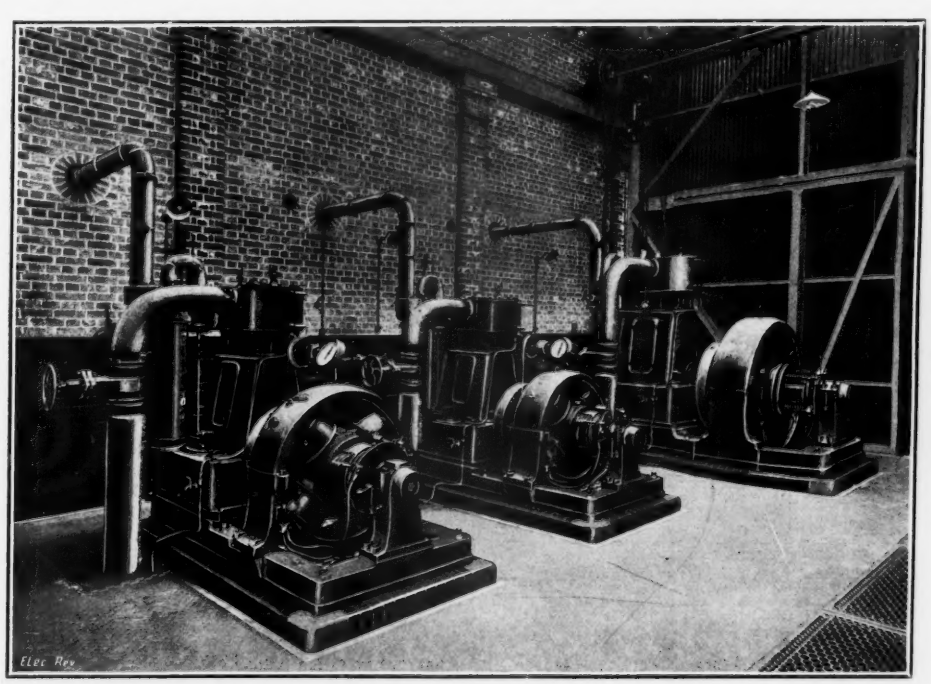
The Perfecta Co. claim to effect great saving in this part of their manufacture through the course adopted in laying out their works. They have their own canal arms and their boilers and furnaces have been erected close alongside, so that the coal is thrown direct from the boats practically to the furnace and boiler doors. The machinery for all processes of manufacture has been arranged so that the work is passed on from machine to machine without unnecessary handling.

The cycle tube department is reached by proceeding over another private branch of the canal; this department is practically a duplicate of the other mill, but on a smaller scale, as the tubes handled are so much thinner and lighter. Here, again, the boilers and furnaces are on the canal side, and the same arrangement of machinery has been carried out. We understand that the output of small tubing runs into millions of feet a year for conduit work only.

The conduit department is quite self-contained in large buildings, and is separate from the rest of the factory.



The Main Switchboard, Caterham Generating Station. (See p. 1038.)



Direct-Current Generating Plant, Caterham. (See p. 1038.)

The Perfecta Co. work on methods of their own; very little of their machinery has been bought from engineers, but has been manufactured specially for conduit making. Care has been taken to prevent delay in the execution of orders, for though for economy the department is driven by the steam engine which works the machinery for the manufacture of the smaller solid-drawn tube, it is provided with electric driving of sufficient capacity to run the whole place in case of any breakages or stoppage.

We give a couple of views of this department taken from different points. Work is proceeding at high pressure owing to exceptional demand. As a matter of fact, the General Electric motor which is provided, as stated, mainly to run the conduit section for emergency purposes, at the time of our visit had been in regular service for a month owing to the general briskness of trade.

We had an opportunity of noting how capacious is the store accommodation; the pipe-store we illustrate, but there is also a large room devoted to the storing of fittings. A large stock is kept at the works of every article mentioned in the company's catalogue, and stocks are also held at the London offices at 86, Charing Cross Road, W.C., and at the Glasgow, Manchester and Bristol branches.

We must leave it to our photographs to convey an idea of the processes of enamelling, tube-making, brazing, manufacture of fittings, &c. One of the departments is stated to have been working continuously day and night for the last ten years.

The directors attribute their success in the conduit trade to their policy of making a high-class quality of material and selling it at a reasonable price, and having refused to join in a cut-throat policy of reducing prices, the necessary result of which they contend has been the establishment of a sort of combine among the other manufacturers, they do

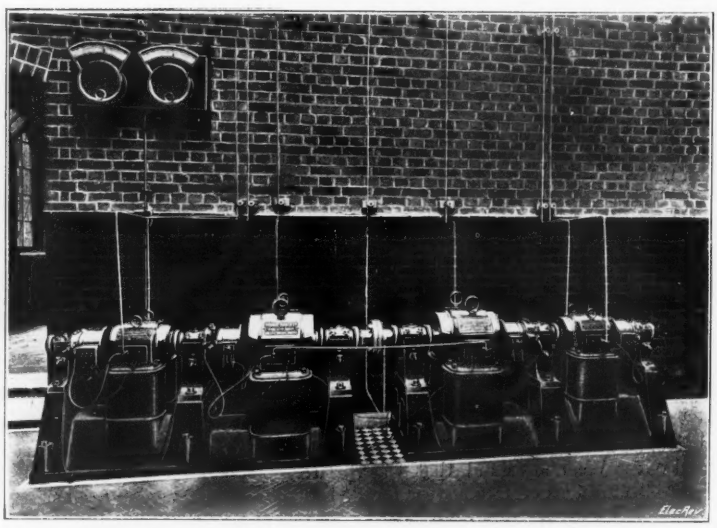
not now feel any necessity for resorting to artificial means for making a profit.

We understand that the company has made an important feature of special water-tight work for Government installations at Devonport, Malta, Portsmouth and Sheerness Dockyards.

THE CATERHAM ELECTRICITY WORKS: URBAN ELECTRIC SUPPLY CO.

Caterham is situated in one of the prettiest spots of Surrey, about 16 miles from London. It is entirely a residential district. Caterham Valley itself is 450 ft. above the level of the sea and the hills around rise from 600 to 800 ft. above the sea level. Often when November fogs are choking the Metropolis, the sun is shining on the green slopes of Caterham.

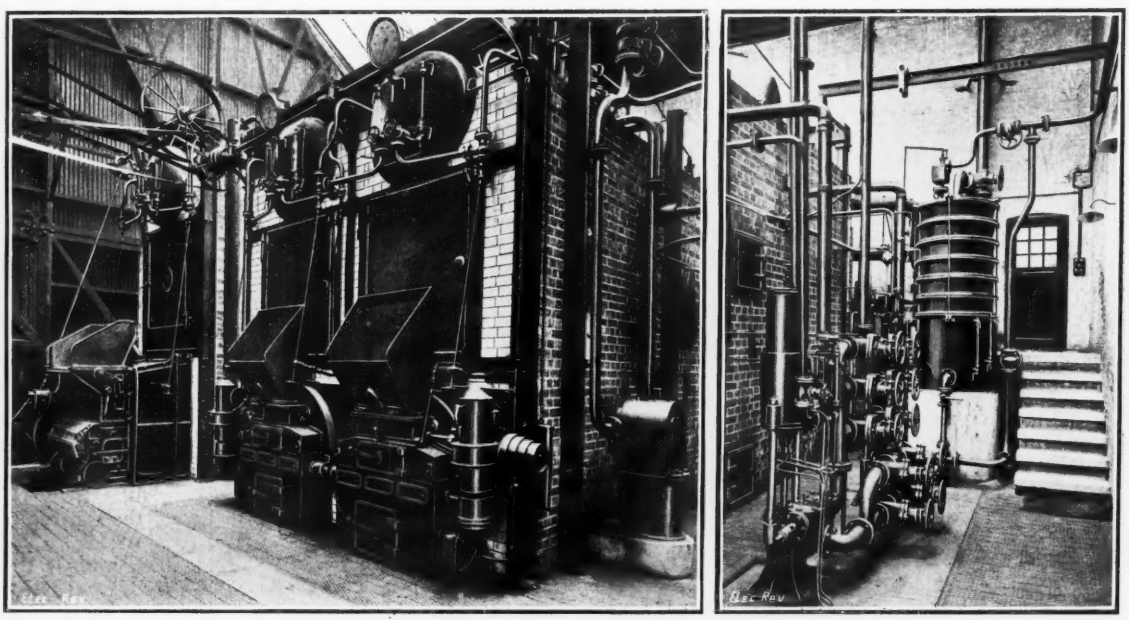
In 1900 the Urban Electric Supply Co., of Westminster, obtained a provisional order for the lighting of Caterham and district, and in due course a site was selected for the generating station in Croydon Road adjacent to the South-Eastern and Chatham Railway, and the position, as far as distribution is concerned, is an excellent one. Building operations were commenced in May, 1903, and although the work was considerably retarded by the exceptionally wet summer of that year, the supply was available for public use by the end of the following October.



The Booster Balancer, Caterham Electricity Works.

It was only intended at the onset to supply the valley part of Caterham, but before the supply started many applications were received from residents at Upper Caterham, and the directors decided to extend the mains there; since then the mains have been extended very largely in that direction. Some time after the cables were extended to Warlingham—a fine residential district also—about two miles from the generating station, this being followed by another extension to supply part of Whyteleafe.

The buildings are very substantial, and include boiler house, engine room, battery room and roomy offices. The boiler house contains three boilers of the water-tube type—two by Messrs. Sugden & Co., and one by Messrs. Babcock and Wilcox—the latter being a recent addition. Steam is supplied at a pressure of 160 lb. per sq. in. Each of the Sugden boilers have 870 sq. ft. of heating surface, and are fitted with a patent superheater capable of imparting from 150° to 160° F. superheat to the steam produced by the boiler. The Babcock & Wilcox boiler has 1,200 sq. ft. of heating surface, and is also fitted with a superheater. The Sugden boilers are equipped with Meldrum stokers, but the Babcock is fitted with a chain grate stoker; all the stokers are motor-driven, and are fed by hand from the coal bunkers. The latter have doors immediately opposite each boiler, and being close to the railway, the coal is unloaded at a stage—a set of rails having been laid down to run the coal direct into the bunkers. This, of course, means a great saving in the course of the year, as to cart coal in the ordinary way would considerably increase the cost of fuel.



Views of the Boiler House, Feed Pumps, Feed Heater, &c., Caterham.

The boilers are fed by two Hall compound double-acting pumps, capable of delivering 20,000 lb. of water per hour

when working at 16 strokes per minute. The feed-water is drawn from four interconnected tanks placed on the roof of the storeroom in the boiler house, the tanks being supplied from the town mains. All feed-water is measured through a Kennedy water meter suitable for dealing with hot water.

The main steam pipe is 4 in. internal diameter, and is of lap-welded steel with heavy wrought-iron forged flanges screwed on, the tube ends being expanded into flanges and riveted upon the face. The steam main is suspended from the wall at the back of the boilers, only the 2½-in. and 3-in. branches leading into the engine room, and it is so arranged that by means of valves any boiler or engine can be isolated if necessary. A 1¼-in. auxiliary steam pipe is installed for supplying the feed-pumps.

The exhaust steam from the engines can be made to pass either through a Boby heater or direct to the atmosphere by means of a valve placed in the exhaust pipe. The feed-water comes in at the top of the heater and mixes with the exhaust steam, which raises its temperature to about 212° F. The action of this type of heater is also to soften the feed-water, and when it is working properly the hardness should not exceed three or four grains per gallon after leaving the heater.

The engine-room plant at present comprises three General Electric Co.'s generators direct coupled to Belliss & Morcom engines; two are of 45 KW. and one of 90 KW., making a total of 180 KW. The large set runs at 475 R.P.M. and the smaller sets at 575 R.P.M. At one end of the engine room a balancer booster is installed. When not running to drive the boosters the balancer is capable of dealing with an out-of-balance load of 90 amperes. The boosters are separately excited at 240 volts and give 70 amperes at 70 volts. An 8-ton crane operated by hand spans the engine room.

The switchboard is situated almost exactly opposite the two small steam sets, and is raised from the floor about 12 in. The whole of the switchboard is by the General Electric Co., Ltd. The board contains five panels, the top part being the negative side, the bottom the positive. Panels 1 and 2 starting from the left-hand side of the board control the three generators. No. 1 panel is a recent addition; it was erected when the large steam set was laid down, and is equipped with instruments, &c., for a future extension. Each dynamo panel is fitted with maximum cut-outs, and combined minimum and reverse-current cut-outs on the positive and negative poles respectively, together with ammeters and watt-hour-meters for measuring the output of the machines.

No. 3 panel provides for the control of the battery and balancer-booster. The battery regulating switches are fixed in the battery room and are fitted with extension spindles, which pass through the wall to the switchboard. The wheels for moving these switches are shown at the top of the panel. The starting resistance for the balancer, and the shunt regulating resistances for the whole of the machines, are placed on the wall at the back of the switchboard and connected to the board by extension spindles exactly in the same manner as the battery regulators. The two wheels below on this panel are in connection with the balancer starter and the balancer field resistance. Below these again, in the centre are the throw-over middle-wire switches, and the wheels on either side are for regulating the booster fields. The watt-hour-meters below measure the battery output or input, as the case may be. No. 4 and 5 panels are for the feeders, but the balancer and battery ammeters are also mounted on No. 4 panel. The feeder panels are only equipped with ammeters and bridge fuses. The board provides for two bus-bar pressures, as seen by the plugging arrangement. To the right and left of the switchboard on the wall are seen the recording instruments; those on the left are positive and negative voltmeters and ammeters; to the right is the earth-recording ammeter, and on the same panel is an electrostatic voltmeter.

The connections at the back of the switchboard as far as possible consist of bare copper rod, which reduces the risk of fire to a minimum; the main connections also from the balancer-booster are made of copper rod, mounted on insulators.

The battery room is immediately behind the switchboard. Here is installed a D.P. battery consisting of 260 cells of the Continental type. The cells are arranged on two floors, and have a capacity of 350 ampere-hours or 180 amperes at the one-hour rate. The connections from the regulating cells consist of copper rod run along the wall nearest the engine room. At one end of the battery room a milking booster is installed for nursing individual cells.

Turning to outside work, the network is fed at three different points, each feeder being ·3—·15—·3 triple-concentric lead-sheathed and armoured, laid direct except in places where chalk has been encountered, in which cases the mains have been laid solid in wood and earthenware troughing. The distributors are three-core lead-sheathed and steel-taped and are laid direct.

The equivalent 8-C.P. lamp connections up to the present number nearly 10,000, including 55 H.P. in motors.

The engineer and manager of the Caterham Electricity Supply is Mr. F. Bruton, who has been responsible for the whole of the work in connection with the undertaking.

LIGHTING and POWER NOTES.

(*Concluded from page* 1034.)

Bristol.—Numerous attacks have been made on the Coroporation's electricity undertaking of late. The gas company loses no chance of criticising it, and the non-political Ratepayers' Association has taken the same line. Early in the month the Electrical Committee presented a report to the Council dealing with such criticisms. A short retrospect of the undertaking was given. Up to December, 1895, the gross profits were admittedly not sufficient to meet financial charges. Up to that date £13,905 was received from the rates. From the year 1895 the profits have been sufficient to meet all charges. The total amount in 1906 standing to the credit of the sinking fund account was £96,139, and in addition profits have permitted the accumulation of a reserve fund, the balance of which, after meeting numerous charges for renewals, amounted at March last to £19,111. It has been the policy of the Electrical Committee at Bristol to apply any surplus net profits in reducing the charges for public street lighting and to private consumers; this is municipal trading in its true sense. The critics of the undertaking allege that the cost of street lighting is excessive, and much higher than in the metropolis. This matter the Committee has gone into fully, and it is proved conclusively that the allegations of the gas company and such are very wide of the mark. We wish that the costs for street lighting in London were as low as is stated in the criticisms on the Bristol undertaking. London is also stated to be going back to gas, but we have dealt with this matter before and shown that such a statement is incorrect.

Canada.—ONTARIO.—Forty-six municipalities have now filed applications with the Hydro-Electric Power Commission of Ontario for a supply of power, amounting in the aggregate to 124,075 H.P. Of this 113,575 H.P. is asked for by municipalities within the Niagara radius, and 8,500 H.P. by those outside. It is understood that the total far exceeds the original anticipations of the Commission's most sanguine supporters, and additional applications are being received daily. To 21 of the municipalities the Commission has been able to give estimated prices at which their requests can be complied with. These vary according to the terms on which the Commission obtains its supply of electricity for transmission. Slightly higher rates are also quoted for quantities less than those specified in the applications received. In each instance the price is for 24-hour supply stepped down to suit consumers. Toronto and Hamilton are expected to submit by-laws to the people authorising the respective Councils to contract with the Commission for a specified minimum quantity of power at a certain maximum price. Many other munipalities will refer to the ratepayers measures including no reference to the quantity to be taken. The by-law suggested for their adoption will, after reciting the terms of the Statute, enact:—"That it shall be lawful for said Municipal Corporation to execute a contract with the Hydro-Electric Power Commission of Ontario for the supply to the said Corporation of electrical energy for the uses of the Corporation and the inhabitants thereof, for lighting, heating and power purposes, at from $..... to $..... per H.P. per annum for continuous power, ready to be distributed by the said Municipal Corporation, such price to include all charges for interest, sinking fund for cost to construct, and the cost to operate and maintain the plant, machinery and appliances to be used."

The Capital Power Co.'s power plant at Deschenes has been disposed of by public auction to the Canadian Pacific Railway for $240,000. The purchase of this plant indicates that the railway company propose at an early date to experiment in the electrification of railways. The line chosen for this purpose would be the Pontiac and Pacific Junction Railway, which runs through Aylmer and Deschenes into Ottawa. For some time past the Canadian Pacific Railway has been considering the question of experiments along this line, but it is understood that it has been awaiting the result of tests by the N.Y. Central and Pennsylvania Railways.

The city of Ottawa is to enter into an agreement with the Ottawa

and Hull Power Co. for leasing not less than 1,500 or more than 3,000 H.P. of electrical energy for the next ten years at a yearly rental of $15 per H.P., the supply to be given at the discretion of the city, and paid for in lots of 100 H.P. This was definitely agreed on at a meeting between the Civic Electric Commission and Mr. A. F. Lobb, of Toronto, solicitor for the Ontario Hydro-Electric Commission. The Civic Commission has asked that a by-law be introduced authorising the agreement. The Commission has also recommended that the Legislature be asked to empower the borrowing of $500,000, on a vote of the property holders, for the purchase and development of a civic power plant, or, in the alternative, for power for the purposes of the municipal electric plant. The Mayor has stated that the policy of the city is to secure a supply of power for ten years, and then to have a power plant belonging to the city. In this way Ottawa falls in line with several other Canadian cities, in order to furnish power at a low price for manufacturing purposes. Winnipeg is now engaged in the preliminary work of construction of a three-million dollar hydro-electric power plant, with the intention of making that city a great industrial centre. Toronto is negotiating with the Ontario Hydro-Electric Commission for a large supply of electrical energy, and the question will be submitted to the ratepayers in January.

The Civic Commission also suggests that the Legislature be asked to pass a law ratifying and confirming the purchase of the Consumers' Electric Co., to avoid further litigation through *ex posto* legislation.

Carmarthen.—The T.C. has asked Messrs. J. B. Saunders & Co., of Cardiff, to submit a scheme of electric lighting to the Council. The firm offers to carry out a scheme at an annual outlay of only £713.

Continental Notes.—GERMANY. — The Magdeburg municipality is about to extend its E.L. station at a cost of £5,000.

ITALY.—Our contemporary, *l'Elettricita*, of Milan, states that whilst the provincial town of Lucca is endeavouring to obtain from the Government the concession for about 3,000 H.P., obtainable at a waterfall near Terchio, which it is intended to convert into electrical energy, a company is likewise entering the field, intending to establish hydro-electric works near Barga. It is probable that not less than 8,000, or even 10,000, H.P. might eventually be generated from the Falls along the Terchio, in the neighbourhood of Lucca.

Darlington.—A L.G.B. inquiry was held on December 18th, into the application of the T.C. for a loan of £7,200 for E.L. purposes. There was no opposition.

Epsom.—The U.D.C. has decided to apply to the L.G.B. for sanction to a loan of £3,600 for additional E.L. plant.

Greetland.—The U.D.C. has asked the Halifax T.C. if it is in a position to supply electrical energy in bulk. This action has been taken owing to an application for an E.L. prov. order being made by the Electrical Distribution of Yorkshire, Ltd.

India.—AMIR'S CAMP AT AGRA.—A correspondent in India states that the Military Works Service at Agra is now installing the electric light in the Amir's Camp. The Government found a difficulty in getting any local contractors to undertake the work, as the matter of lights seems to have been overlooked until the last moment. Only one Calcutta firm could be found to tender for the Fort installation, and its tender was gladly accepted. The Viceroy's Camp, and the camps of the various Lieutenant-Governors, are being lighted by the engineers of the various provincial Governments, under the general supervision of the electrical adviser to the Government of India. Contractors cannot be expected to be prepared for sudden emergencies when generating plant is required, because for permanent installation work they are generally ignored, and Government plant is imported direct from home through the Secretary of State.

MUSSOORIE WATER-POWER SCHEME.—This scheme, after undergoing a long process of incubation, is now within reasonable distance of becoming an accomplished fact. Tenders have been accepted for the turbines and electric generators, and arrangements are being made locally for erecting the line poles. The transmission line will be about 8 miles, and three-phase current at a pressure of 6,600 volts has been decided upon. Transformers will reduce this to the ordinary 225-volt working pressure. A considerable lighting load is anticipated, and it is expected that the municipality will be in a position to do productive work by next season. An attempt is to be made to embark on municipal wiring, but local property owners are sceptical about the suggestion, and unless the terms are very favourable, will probably prefer to entrust their work to experienced Calcutta firms. It is rumoured that a large quantity of house-wiring material has already been imported by the Council in its eagerness to commence work; but as the success of the water-power scheme of the sister hill station, Darjeeling, is at best but a qualified success, people in Mussoorie are not over enthusiastic to install lights until they are certain of the continuity of supply, and have some tangible proof of its reliability.

CHITTAGONG.—The newly-appointed electrical engineer to the Province of Eastern Assam and Bengal has lately been deputed by his Government to make an inspection and give a report of the water power available at the Barhat Rapids on the Karnafuli River. It has been suggested by the local engineer that a sufficient quantity of water might be made available for transmitting energy to Chittagong—50 miles distant. If the electrical engineer's report be favourable, the Government will, no doubt, have the matter put in hand forthwith. The town of Chittagong is almost certain to become a port of very considerable importance within a very short time, owing to railway extensions, and mainly, perhaps, due to the fact that it has been officially designated the second capital of the newly constituted province of Eastern Assam and Bengal, and electric tramways and lighting are inevitable.

London.—L.C.C. SCHOOLS.—At the meeting of the Education Committee of the L.C.C. on Wednesday, a report was presented from the Buildings and Attendance Committee as to the relative cost of gas and electric lighting in the schools of the Council. The committee on October 24th decided to forward to the Finance Committee the information contained in its report with reference to the comparative estimated cost of lighting the schools by gas or electricity, and the expenditure incurred upon incandescent mantles and gas fittings, together with copies of detailed statements submitted in manuscript. The Finance Committee had stated that it was of opinion that, in view of the question raised by Mr. Cobb upon the latter point, the substance of the information should be reported to the Council in order that it might be made fully acquainted with the arrangements in force for securing economy in the distribution and use of gas mantles and fittings. After carefully considering the matter, however, the Committee had arrived at the conclusion that no useful purpose would be served by adopting the suggestion of the Finance Committee. The relative merits of incandescent gas and electric light were, to a great extent, a matter of opinion, for though it might, perhaps, be shown that the former method was cheaper, the latter was undoubtedly far preferable from a hygienic point of view.

DEPTFORD.—The B.C. has passed a resolution expressing disapproval of the L.C.C. Electric Supply Bill, and requesting the borough representatives in Parliament and on the L.C.C. to use their best endeavours to secure the rejection of the measure. Various councillors described the Bill as preposterous and scandalous, and said it was time to put a stop to the creation of L.C.C. monopolies.

HACKNEY.—A recommendation was adopted on the 21st inst., by the E.L. Committee, to expend £15,569 on additional plant, &c., at the electricity works in order to cope with the increasing demand for energy.

MARYLEBONE.—Considerable inconvenience was caused on Wednesday evening last week, by the failure of supply along the north side of Oxford Street. Fortunately, however, it did not last very long. We understand that a flash over occurred on the commutator of one of the machines.

WOOLWICH.—Sir Alexander Kennedy has prepared a special report on the B.C. electricity undertaking, and according to the brief statements on the matter which have appeared in the daily Press this week, he states that the undertaking must be reorganised; that it cannot be made remunerative for several years; that it is unfortunate that there are two fully-equipped stations in the borough, and that he is of opinion that with very little alteration the whole of the energy required for the district could be generated in one of them. There is too much H.T. machinery at the Plumstead station which is not required, and much of it is lying idle. He considers that the load should be principally taken by the station in Woolwich, and he advises the Council to consider the advisability of taking a bulk supply from the South Metropolitan Electric Supply Co. at Greenwich, before incurring additional expenditure. He states that the staff is too large, and points out that nothing has been put by for depreciation.

We understand that there is a bank overdraft of over £29,000 on the undertaking.

MARYLEBONE.—The account of Mr. Wright, consulting electrical engineer, for commission at the rate of 4 per cent. on capital expenditure (£53,287) during the six months ending September 30th last has been passed by the Borough Council. The total amount of commission previously paid to Mr. Wright was £19,875. A claim by Messrs. D. H. Evans & Co., in connection with the change of pressure at their premises in Oxford Street, is to be referred to arbitration.

WANDSWORTH.—The General Purposes Committee has had under consideration the subject of testing the electricity supplied by the County of London Electric Supply Co., and has recommended that the attention of the L.C.C. be called to the long correspondence which has taken place between the two Councils on the subject, and that the C.C. be urged to take steps without further delay to secure the due testing of the supply in the borough, and to compel the company to provide testing stations in accordance with the provisions of the Order. The B.C. has adopted the recommendation.

Lytham.—The U.D.C. has passed a resolution to apply to the B. of T. for an E.L. prov. order, which is to be transferred to a private company.

Mynyddislwyn.—The U.D.C. has decided to support the application for a prov. order for E.L. by the Rhymney Valley Electric Supply Co. on condition that the Council has the option of purchasing the undertaking at the end of 21 years, that the charge for energy for public lighting shall not exceed £2 17s. 6d. per annum per 16-C.P. lamp, and that the charges to private consumers shall not exceed the charges in any other part in the area of supply.

Newark.—The T.C. has applied to the B. of T. for an extension of the E.L. order which expires this month.

Rossendale.—The Rawtenstall T.C. has decided to erect a generating station of its own if a decision is not come to at a very early date for a joint electricity scheme for Bacup, Haslingden and Rawtenstall. The Corporation has also resolved to oppose the application of the Lancashire Electric Power Co. for an order empowering the company to supply electricity in Bacup, Rawtenstall, Haslingden and Ramsbottom, and further, to purchase the

Accrington Corporation Steam Tramways Company's undertakings in the Borough of Rawtenstall, and to give the company notice requiring it to sell the same.

South Africa.—Indwe (Cape Colony).—A public electric lighting supply is being inaugurated by the Indwe Colliery and Land Co., both for the lighting of the streets and for private consumption. The construction work, which is being carried out by Messrs. Ryan & Peterson, of East London, has already made considerable progress. The system is a 440-volt direct current two-wire supply with one wire earthed. The supply is obtained from the generating station at the Colliery, which is equipped with electric lighting and power for haulage, pumping, coal cutting, &c. Consumers' premises are wired for two 220-volt lamps in series. Practically all the wiring on consumers' premises is being done for the Supply Co., who are willing to allow payment to be spread over a period of years. The price per unit to private consumers is to be 6d.

Tiverton.—The Board of Trade has notified that it has revoked the Tiverton E.L. Order, 1890, as from December 12th, 1906.

Tynemouth.—The T.C. is considering the advisability of hiring out motors and installations generally.

West Ham.—As an experiment the electrical engineer has been authorised to supply 10 arc lamps, including energy, to private consumers, at a fixed rate of 40s. a quarter based on a use of 800 hours per annum, the numbers of hours to be kept by means of clock meters and additional hours above the 800 to be charged for at 2¾d. per hour. After a sufficient interval a report is to be made upon the working of the experiment.

TRAMWAY and RAILWAY NOTES.

Argentina.—The Austrian Consul at Buenos Ayres reports that the tramway traffic in that city greatly increased in 1905. In Buenos Ayres alone, there are 10 tramway companies, of which four have adopted electric traction; the other six will probably also adopt electric traction in the near future. The capital invested in these undertakings amounts to 57,000,000 pesos, and the number of passengers carried in 1905, was 150,000,000 on a total length of line of about 500 kilometres.

Australia.—Melbourne.—The Kew Council recently approached the Melbourne Tramway Co. on the subject of the electrification of the lines within the municipality. The company offers to electrify the present service if the Council will pay the cost and recoup the company its outlay on the termination of its lease, 10 years hence. It appears that the offer, on these terms, is not satisfactory to the Council.

A Reuter telegram states that the South Australian Parliament has approved the proposal for the purchase by the Government of the Adelaide tramways. The lines are to be immediately electrified and managed by a board comprising representatives of the Government and all the metropolitan and local governing bodies. A loan of £280,000 to cover the purchase money is to be raised forthwith locally.

Blackpool.—At the annual meeting of the Blackpool, Lytham and St. Anne's Tramways Co. this week end, a profit was declared of £6,899. There was a net increase in the traffic receipts of £2,500, and the working expenses had been reduced from £18,306 to £17,279. It was proposed to pay a dividend of 2½ per cent. As the £150,000 debentures only require £7,500 a year, the company is within measurable distance of being able to pay the whole of the interest.

Burnley.—The Corporation has decided to at once begin to lay a new line from Padiham to Whalley, a distance of four miles. It is also intended to further extend the system to the outlying village of Sabden, which is four miles to the north of Whalley, the latter being a favourite resort for thousands of people on Sundays, in both summer and winter.

Channel Tunnel Scheme.—This Bill was deposited in Parliament last week to incorporate the Channel Tunnel Co., and to authorise the construction of works which shall form part of the scheme intended to connect England and France by means of a railway in a tunnel under the English Channel. Powers are sought to execute such works up to the three-mile limit, and it is proposed that a new company shall hereafter be registered for the purpose of carrying out the entire project, in conjunction with the Compagnie du Chemin de Fer Sous-Marin entre la France et l'Angleterre and the Compagnie du Chemin de Fer du Nord. The Bill empowers the South-Eastern and Chatham Railway Co.'s to avail themselves of the authority given by Parliament in 1874 for the application of their capital towards the cost of the works, and also to take shares in the capital of the company created. It is further provided that the exercise of any powers granted shall be subject to such conditions as may be agreed between His Majesty's Government and the French Government. It is estimated that the scheme will involve a total outlay of £16,000,000. It is proposed to construct two parallel tunnels, the total length thereof under the sea being 24 miles and, with the land approaches on either side, 30 miles. It is calculated that in the first year after opening, the "Caldover Tube," as it is described, will convey 1,300,000 passengers, and the gross receipts are put at £1,540,000. British and French engineers estimate the annual expenses at £400,000, leaving a net profit of £1,140,000. The tunnels, each 18 ft. internal diameter, will be driven from Dover to Sangatte, throughout the whole distance in the grey Rouen chalk, which, 87 ft. thick on the English side and 80 ft. on the French side, is a stratum very homogeneous, practically free from, and remarkably impervious to, water. Power for the electric trains which are to be employed in the tunnel traffic will be obtained from large generating stations, which are likewise to supply the energy required for lighting as well as the compressed air necessary for the purposes of ventilation. The trains will be made up of the rolling stock of all British and Continental railway systems, excepting those of Spain and Russia, which at present possess gauges differing materially from those of Great Britain. When the trunk line now in course of construction through Greece has been completed, the opening of the Channel Tunnel will shorten the mail route to India by 26 hours. We understand that Mr. Balfour Browne, K.C., has been retained as leading counsel for the Bill, and Messrs. Sherwood & Co. are the Parliamentary agents.

Colwyn Bay and Llandudno.—Opposition to the Colwyn Bay and Llandudno Light Railway scheme has been withdrawn by the Llandudno U.D.C., conditional on the tramway company widening Rhos Road, at a cost of £2,500, and paying £3,000 to the Council for other street widenings.

Continental Notes.—Switzerland.—Aerial railway between Chamonix and Mont Blanc. The Geneva company which carried out the construction of the aerial railway to the Wetterhorn, has definitely approved the construction of an aerial line between Chamonix and Mont Blanc.

Italy.—The *Official Gazette* of Italy publishes the authorisation to the Varese Ruisaal Co. to construct and work a funicular railway up the Campigli Mountain.

At the end of 1904 there were 79 tramway companies operating 294 lines in Italy, having a total length of 3,655 kilometres. Nearly one half of the lines are described as being suburban.

It is reported from Milan that the Government has now definitely decided upon the conversion to electric traction of various sections of the State railways. In the first place, the scheme concerns the Lecco-Milan section which is to connect the electrically-operated railway on the left bank of the lake of Como with Milan. The line branching from this electric railway to Bergamo is also to be electrically equipped, together with the feeder line from Milan to the Simplon tunnel, the connecting line to the Gothard railway, Milan-Luino on Lake Maggiore, the Giovi tunnel on the Milan-Genoa line, and the tunnel under the town of Genoa. In addition to these, the transformation scheme comprises in central Italy the section over the Apennines between Florence and Bologna, and in southern Italy the section Naples-Salerno, together with the branch Torre-Anunziate-Castellamare Stabia. The Government estimate for these works amounts to £1,240,000. Apart from the State railways, the Southern Railway Co. in association with the Commercial Bank and the firm of Breda & Co., contemplate the construction of an electric railway between Milan and the industrial district of Bergamo at an outlay of £800,000, and a direct electric line from Milan to Genoa. Both these projects are opposed by the State railways on the ground that they would introduce severe competition, but as the company does not ask for any subsidy, it is thought that the plans will be settled in the general interest of the country. One department of the Public Works Board has just decided in favour of the schemes, notwithstanding the opposition of the representatives of the State railways, but the final decision rests with the higher department of the board, and has yet to be determined.

France.—According to *La Revue Electrique*, a scheme is in course of preparation for the electrification of 740 kilometres of the network of the Chemins de Fer du Sud de la France alternating current at high pressure being employed. It is probable that the cars will be equipped with single-phase motors, and that the pressure of the supply current will be between 6,000 and 8,000 volts.

Besides the electricity supply problem in Paris, the Municipal Council is in trouble in connection with the suppression of the temporary trolley system in the Rues Réaumur and 4-Septembre. According to the *Temps*, the city finds itself in a cruel embarrassment. When the roads were taken up to build the Métropolitain underground railway, the conduit system was replaced by that of the trolley, but it was understood that this was merely a temporary arrangement, and that when the Métropolitain was completed the *status quo ante* was to be returned to at the cost of the city. With this object in view, the Council voted last year a credit of 550,000 fr. for the reconstruction of the tramway lines, and 400,000 fr. for the making up of the roads and footpaths. The tramway company, however, demands 965,000 fr. for carrying out the works, and, moreover, a further sum of 4,268,000 fr. for general damages occasioned by the construction of the railway. Failing an agreement, a proposal was made by the Prefect of the Seine for the city to carry out the works. Unfortunately, the tramway company announced its intention to oppose this step on the part of the city, and a resort to law offering little prospect of success, the municipal authorities have been advised by the Prefect to compromise by an offer of 1,000,000 fr. If this is accepted the trolley will in about eight months disappear from the Rues 4-Septembre and Réaumur; but the solution of the deadlock will involve some inconveniences. If the conduit system is laid from the Place de l'Opéra to the Avenue de la République it will render permanent the use of the trolley from the latter thoroughfare to the fortifications; for the company

will not bear the cost of installing the conduits along the whole route. The Municipal Council, up to the present, has only sanctioned the trolley system as far as the outer boulevards. Hence the question is not yet freed from serious difficulties.

Germany.—An electric tramway is to be constructed between Nerdingen, Hornberg and Duisburg. The work is expected to occupy a period of two years.

East Africa.—At the meeting of the Delagoa Bay Development Corporation, held in London recently, Mr. H. K. Heyland stated with regard to the electric tramways that the passenger receipts had somewhat improved, but in the opinion of the directors, until Lorenço Marques had about double its present population, the company could not expect any material increase in their low passenger receipts. There had, however, been some development in goods traffic, and the board were considering the advisability of carrying out some small extensions with a view to still further developing this source of revenue.

Gateshead-on-Tyne.—At a meeting of the Wrekenton Tramways Extension Committee held on the 19th inst., a letter was received from the B. of T. on the question of the completion of the Wrekenton branch of the Gateshead and District Light Railways. The Board found that the objection lay mainly in the fact that when the colliery cable line, which route the light railway would cross, is working, the wire rope rises above the level of the ground, and is stretched across the light railway track. In May, 1903, the Board told the promoters on the advice of its inspecting officer, who visited the place, that it would be necessary to render it impossible for a car to cross the wagon-way while the rope was up. The promoters' engineer accordingly prepared a scheme for connecting the movement of the rope with signals on the light railway, but the Board had to point out that there was still nothing to prevent this rope being pulled taut when a car had already passed the signals and was just on the point of crossing the cable lines. Since then no further proposal had been put before the Board. It, of course, rested with the promoters to suggest a device for getting over the difficulty. The B. of T. intimated, however, that its inspecting officer would be glad to consider and advise upon any method which might be submitted. It was decided to endeavour to get the T.C. to take up the matter.

Jarrow-on-Tyne.—The whole of the track having been put into perfect working order, the entire route between Jarrow and Tyne Dock has been brought into use.

Launceston.—(Tas.)—The Launceston Tramway Bill has passed both Houses of the Legislature. One of the clauses was so amended as to give power to the Corporation, in the event of the company failing, to carry on the undertaking.—*Australian Mining Standard.*

Leyton.—A collision occurred on the 20th inst. between two of the U.D.C. cars on the Leytonstone Road. The passengers were severely shaken, the conductor was injured, and the cars were badly damaged.

London.—L.C.C.—The Highways Committee, in the course of a report presented to the County Council on Tuesday last week, referred to the question of motor-omnibuses, against which there was still serious ground for complaint in regard to noise, odour and vibration. According to the police returns for the year ended May 31st, 1906, there were 2,488 accidents and 770 breakdowns in connection with motor-omnibuses, and the number of accidents caused by such vehicles was 361 in July, 436 in August, and 469 in September. The motor-omnibus was particularly liable to accident, and the Council's tramcars had on many occasions been blocked by breakdowns of the former class of vehicle. After quoting evidence given before the Select Committee on cabs and omnibuses as to the effect of motor-'buses on road surfaces and foundations, the Committee stated that the lubricating oil dropped on the roadway had a very serious effect upon asphalt roads. The maintenance of the County Council's tramway tracks during 1905-6 involved an expenditure of £26,293, or about £525 per street-mile, and the rates paid on the permanent way amounted to £13,358, or about £267 per street-mile. Apart from the wear of the paving, serious trouble was being experienced in connection with the insulators and manhole covers owing to the constant heavy pounding action of the 'buses. It appeared to the Committee to be inequitable that the Council should have to lay down and maintain a track largely used by other vehicles plying for hire, while the proprietors of such vehicles were not required to contribute towards the maintenance of that or any portion of the road. In the circumstances the Committee recommended the Council to urge the Secretary of State to give effect to the recommendation of the Select Committee as to the desirability of public control over the routes of omnibuses, and to suggest the initiation of legislation so as to require a proper contribution to be made by the owners of motor and other omnibuses towards the cost of maintaining the streets.

Two new tramway routes were opened on Saturday afternoon last, from Tooting Broadway through Earlsfield, Wandsworth, Battersea and Vauxhall to the Hop Exchange, a distance of over eight miles; at the same time a service was inaugurated between Clapham Junction and Westminster.

Manchester.—With regard to new tramway lines in the Withington district, much opposition has arisen locally to the construction of tramways along the Wilmslow Road, from Withington to Didsbury; and the Corporation Committee has resolved, as regards this line, that application for the Committee's Bill should go forward, but that a definite undertaking should be given to postpone the carrying out of the powers to be obtained as long as possible. The Committee has pointed out that it is bound to this course by the provisional order obtained by the Withington Council before the amalgamation of the district with Manchester. The same circumstances apply to the Wilbraham Road route. A line is projected along Great Western Street, Moss Side, which is considered to be necessary, in order to relieve the congestion of traffic in that district.

Middlesex.—Messrs. William Griffiths & Co. have served a writ upon the County Council for breach of contract in relation to Light Railway No. 3 (Great North Road) Order, 1901. The County solicitor has been directed to defend the action.

Newcastle-on-Tyne.—The Tramways Committee has been considering the possibility of constructing a line by which it could join the Scotswood route with the Elswick Road route. These two routes, starting at practically the same point, gradually diverge until they are about a mile apart, where it is thought desirable, if practicable, to join the two routes by a line passing through a district now being rapidly developed. The city engineer and the tramways manager have prepared reports which show that great difficulties would have to be overcome and the cost would be very heavy. Owing to the gradients it was found that the tramways would have to be made independent of the street at one place. To buy property for that purpose and to make a tunnel would raise the cost to about £111,000. The whole matter is to be discussed at a meeting of the committee a few weeks hence. The committee has determined to appeal against the assessment of the tramways, which now stands at £25,000.

West Ham.—The following basis of agreement has been arranged with the L.C.C. for the working of the section of the London lines between Bow Bridge and Coborn Road: L.C.C. to construct track and overhead equipment; to supply power, and to maintain and repair track. West Ham to supply and maintain overhead electrical equipment; to manage and work the section. L.C.C. to guarantee West Ham 5·68d. for each car-mile run, and half of all receipts in excess of an average car-mile earning of 12·75d.

York.—It appears that the price agreed upon between the Corporation and the York Tramways Co. for the purchase of the undertaking of the company is £11,000, with a small additional sum to cover contingencies.

TELEGRAPH and TELEPHONE NOTES.

Evans v. The National Telephone Co.—The Court of Appeal has upheld the decision of the County Court in this case, to the effect that the structure at the top of a telephone pole is not a scaffolding.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	
Paramaribo-Cayenne	Nov. 27, 1906	
Cayenne-Pinheiro	Aug. 13, 1902	
St. Lucia-Martinique	May 7, 1902	
Dominica-Martinique	May 7, 1902	
Guadeloupe-Martinique	Aug. 29, 1906	
Mole St. Nicholas-Port au Prince	Aug. 16, 1906	
Curacao-Coro	Closed	
Curacao-La Guayra	Jan. 12, 1906	
Curacao-Maracaibo		
Reissa-Issa and Reissa-Yemani (Yemen)	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Port Arthur-Chifu (Closed)	Mar. 9 1904,	
Garachico-Santa Cruz	July 12, 1906	
Las Palmas-Arecife	Aug. 18, 1906	
Guantanamo-Mole St. Nicholas	Nov. 22, 1906	
Mole St. Nicholas-Cap Haytien	Nov. 22, 1906	
Gibraltar-Tangier	Dec. 3, 1906	
Fao-Bushire	Dec. 4, 1906	
Odessa-Kilios	Dec. 14, 1906	Dec. 19.
Tenedos-Salonica	Dec. 16, 1906	
Martinique-Paramaribo	Dec. 17, 1906	
Trinidad-Demerara (No. 2.)	Dec. 18, 1906	
Landlines.		
Puerto-Barrios	Aug. 28, 1902	

CONTRACTS OPEN and CLOSED.

OPEN.

Australasia.—January 14th. According to *Australasian Hardware and Machinery*, tenders are being invited for telephones (9,000), magneto wall sets, for the Postmaster-General's Department, Commonwealth of Australia. Specifications, &c., at the Offices of the Deputy Postmaster-General, Sydney, Melbourne, Brisbane, Adelaide, Perth and Hobart. Tenderers to state name of country in which telephones will be made. Deposit, 5 per cent. on the amount up to £1,000, and 2½ per cent. on any further amount in excess of £1,000. Tenders to Deputy Postmaster-General, Melbourne.

Belfast.—December 31st. 1,000-kw. steam dynamo and condensing plant for the Corporation. See "Official Notices" December 7th.

Bray.—January 1st. High-tension switchboard and instruments for the U.D.C. electricity works. See "Official Notices" November 30th.

Bridlington.—January 19th. Pumping machinery for the Corporation waterworks. See "Official Notices" November 30th.

Ebbw Vale.—December 31st. Prepayment meters for the U.D.C. See "Official Notices" December 14th.

Iceland.—March 31st. The Reykjavik Town Council is open to give a concession for the supply of electrical energy and gas. See "Official Notices" December 7th.

Islington.—December 28th. Fan 12 ft. diameter, and single-phase motor for driving the same, for the Lighting Committee. See "Official Notices" December 7th.

Kingston-upon-Thames.—December 31st. Electric wiring of new schools for the Education Committee. See "Official Notices" December 14th.

Launceston (Tasmania).—January 21st. Three-phase motors for one year. See "Official Notices" December 7th.

L.C.C.—January 22nd. Thirteen induction motor-generators of 500 KW., and four of 150 KW. capacity. See "Official Notices" December 21st.

L.C.C.—January 22nd. 200 or 300 double-deck roof-covered car-bodies; 300 pairs of maximum traction swing bolster trucks; 300 electrical equipments for operation upon the overhead trolley and conduit system. See "Official Notices" to-day.

Middlesex.—The sum of £104 is to be expended in fitting fire alarms, telephones, and installing electric light in the head attendant's and engineer's houses at Napsbury Asylum.

Salford.—January 7th. The Tramways Committee invite tenders for an installation of electric light at the receiving offices, mess rooms, &c., Central Car Depôt, Frederick Road, Pendleton. Specification, &c., on application to the General Manager, Tramways Department, 32, Blackfriars Street, Salford (one guinea deposit).

Spain.—January 11th. Messrs. Emilio Carles Tobra and Javier Emilio Irene have applied for the concession of a narrow gauge electric railway between the Calle de Caspe and the Caserio de San Ginés d'Agudello, Barcelona. The *Board of Trade Journal* says that one month from the above date is allowed for the presentation at the Directorate-General of Public Works, Madrid, of other applications for this concession on terms more favourable to the Government.

Spain.—February 18th. Tenders to the Directorate-General of Public Works, Madrid, for the concession of an electric tramway in Vigo, in accordance with conditions set forth in the *Gaceta*. The *Board of Trade Journal* points out that an application for this concession has been made by Don Laureano Salgado, who, at the same rates, will enjoy certain preferential rights over other tenderers. A deposit of 3,757 pesetas (about £136) is required to qualify any tender. Local representation is necessary. The *Gacetas* may be seen at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, E.C.

Spain.—The municipal authorities of Boicarente (province of Valencia) have just invited tenders for the concession for the electric lighting of the town during a period of six years.

Switzerland.—The municipal authorities of Sterzing, in the Tyrol, are about to invite tenders for the electric lighting of the town.

Wandsworth.—January 7th. Electric lamps for the B.C. See "Official Notices" December 21st.

West Ham.—Tenders are to be invited for 20,000 tons of coal, in parcels of not less than 2,500 tons, for delivery during the year commencing March 31st next.

Wigan.—At a recent meeting of the E.L. Committee the engineer was instructed to advertise for tenders in respect of additions required in connection with the electricity station.

CLOSED.

Brighton.—The T.C. has accepted the tender of the British Westinghouse Co. for additional motor-generator plant, at £2,037.

Glasgow.—The Corporation Electricity Department has decided to recommend the Council to place an extension order with Messrs. Willans & Robinson, Ltd., Rugby, for a 1,700-KW. continuous-current turbine set, including the necessary electrical generators and the surface condensing plant. This set is required in the direction of extensions, and will be the second set of this type installed at their St. Andrew's Cross Station.

Manchester.—A £20,000 contract for the supply of a 5,000-KW. turbo-alternator set, with condensing plant, for the Corporation generating station in Stuart Street, was secured on December 19th by Messrs. Willans & Robinson, Ltd.

Southend-on-Sea.—The T.C. has accepted the tender of Messrs. Miller & Co., Edinburgh, for the supply of five pairs of car wheels, at £20 12s. 6d.

Walthamstow.—The U.D.C. has accepted the tender of Messrs. Dick, Kerr & Co. for the following supplies in connection with the extension of overhead equipment:—36 No. 1 standard poles, £7 7s. 6d. each; 24 sets of scroll-work, 11s. 8d. per set.

Worksop.—The U.D.C. has contracted with Messrs. Chamberlain & Hookham for a year's supply of electricity meters.

FORTHCOMING EVENTS.

January 1st, 3rd and 5th.—At 3 p.m. Royal Institution of Grea Britain. Mr. W. Duddell on "Signalling to a Distance, from Primitive Man to Radio-telegraphy."

NOTES.

A Bright and Prosperous New Year.—To every spot on this earth where the ELECTRICAL REVIEW has a reader and friend we are anxious to dispatch with these lines our hearty good wishes for a happy and prosperous New Year. May every British electrical manufacturer and trader, professional man and worker, be abundantly blessed during 1907 with a healthy development in every section of the industry! May it be a year of big business and reasonable profits—then many other things that we might wish for are sure to come.

The Electrical Engineers' Ball.—As we briefly announced last week, the fourth annual Electrical Engineers' Ball is to take place at the Hotel Cecil, on Friday, January 18th. The following is a list of the Committee and officers:—

Committee.

Alabaster, H.	Leaf, H. M.
Atkinson, Ll. B.	Lloyd, G. C.
Birnbaum, I. B.	Madgen, W. L.
Bowden, H.	Massey, W. H.
Bowden, H. W.	Mordey, W. M.
Callender, Jas.	Morse, Sydney
Carolan, E. A.	McMahon, P. V.
Clift, A.	Nalder, F. H.
Dobson, S. T.	Partridge, G. W.
Erskine, R. S.	Pearson, H. A.
Fell, A. L. C.	Petersen, J.
Flett, G.	Preece, Sir W. H.
Fox, E. T.	Raworth, J. S.
Gatehouse, T. E.	Rider, J. H.
Gavey, J.	Roberts, M. F.
Geipel, W.	Robinson, Mark
Glazebrook, Dr. R. T.	Rosenthal, J. H.
Gray, Jas.	Sharp, Sidney
Gray, R. Kaye	Siemens, Alex.
Hadley, A. E.	Sillar, A. M.
Hammond, R.	Smith, Fredk.
Harrison, H. E.	Spagnoletti, J.
Hirst, H.	Stretche, T. E. P.
Highfield, J. S.	Sutton, G.
Kempe, H. R.	Sawtelle, E. M.
Kingsbury, J. E.	Taite, C. D.
Kavanagh, A. L.	Taylor, J.
Lacey, E. M.	Wallis-Jones, R. J.
Lane, W. E.	

Executive Committee.

Kingsbury, J. E.	Wallis-Jones, R. J.
Lloyd, G. C.	Roberts, Martin F.

Hon. Treasurer.—Hammond, R.

Hon. Secretaries.

Sillar, A. M.	Alabaster, H.

Electric Shock Fatalities.—It is reported that on 21st inst. at the Clyde Valley Electrical Supply Co.'s Burnham Switch House, at Hamilton, a foreman electrician in the employ of the Westinghouse Co., named Harold Weston, lost his life. Reports say that he had lifted a live wire when his head came into contact with a switch, with the result that a powerful current passed through his body, killing him instantly. The deceased was 30 years of age.

At Wellington (N.Z.) early in November a carter, named Wm. Wilson, was killed by coming into contact with a 1,000-volt electric wire. He was engaged in carting timber from the wharf to Kilbirnie, and jumped off his cart to remove a fallen wire, off part of which the insulation had been torn. Immediately he touched the wire he fell, and death was practically instantaneous

Appointment Vacant. — Fitter and erector for installation in Argentine Republic on six months' engagement. (£25 per month.)

Electrical Material for India.—The Government of India have decided to exempt plant and materials for electric installations from the operation of the ordinary rule for the supply of articles of foreign manufacture, so that all such stores may now be obtained under proper authority from any reputable firm either in India or Burma.—*Indian Trade Journal.*

Prize Competition.—The Société des Agriculteurs de France has decided to bestow, during its session of 1907, an award of an object of art or its value in money, to the author of the best scheme for the production, transmission and distribution of electric power and light for the furtherance of agricultural enterprises. The scheme must include the construction of a central station, with water or other generating power, attached or otherwise to an existing sugar factory, distillery or other industrial undertaking and furnishing sufficient energy for the supply of motive power and light to neighbouring districts. The advantages of the scheme over existing methods are also to be indicated, as well as the cost of installation and working.

Parliamentary.—*Rawtenstall Corporation Tramways.*—The estimates of the expenditure on tramways for which the Rawtenstall Corporation is seeking powers in the ensuing session of Parliament are as follows:—Reconstruction of the Accrington tramways, £8,900; reconstraction of Rossendale tramways, £32,300; reconstruction of Bacup tramways, £17,600; construction of new tramways to be authorised by the Act, £55,000; electrical equipment of the tramways, £60,530; purchase of rolling stock, £21,780; provision of omnibuses, £8,000; purchase of motors and apparatus in connection with the electrical undertaking, £3,000; total, £207,110.

The *Metropolitan and Metropolitan District Railway Companies.*—Mr. Carr-Gomm and Mr. W. Benn have asked questions in the Parliamentary papers relative to the inconvenience caused by the discontinuance of the direct train service from the City to New Cross *via* Rotherhithe and Deptford Road. Mr. Lloyd-George, in reply, states that he communicated with the Metropolitan and Metropolitan District Railway Companies on the matter, and was informed that the withdrawal of their steam trains upon the adoption of electrical traction on their lines had necessitated the discontinuance of the through service referred to, as the joint committee of the six companies to which the East London Railway is leased has not yet seen its way to equip that line for electrical working.

London and North-Western Railway Bill.—According to the *Times*, this Bill for next Session asks for powers for the construction of an underground station at Euston and subway for foot passengers under Euston Square Gardens and the electric line between Euston and Watford. "The Bill also contains powers for the construction of an electric generating station at Twyford, between Willesden and Harrow. The capital powers are £2,700,000 in preference or ordinary, and £900,000 in debenture stock. The provision for a subway seems to point to an intended access to the Metropolitan Railway."

Will.—According to the *Times*, the late Sir Richard Tangye left estate of the gross value of £226,319, of which the net personalty has been sworn at £219,454.

Boiler Explosion.—A disastrous boiler explosion occurred on Thursday afternoon last week at the generating station of the South Metropolitan Electric Light and Power Co. at East Greenwich. Two men who were in the boiler house at the time were instantly killed; one was the boiler attendant and the other an inspector of Messrs. Babcock & Wilcox. Up to the time of the accident everything was working quite satisfactorily. Fortunately, fire did not break out. The explosion was due to the back end plate of one of the thermal storage drums on one of the boilers giving way. As might be imagined, much damage was done, and several men were injured; and the supply of electricity was interrupted. We hope to publish further details next week.

Electric Supply from the Pit Bank.—A comprehensive undertaking for the supply of energy over an enormous area from the pit bank is that upon which the Rhenish-Westphalian Electricity Works Co., of Essen, has embarked for the industrial region of the province of Westphalia and adjoining districts. Assisted by coal owners or merchants, of whom Herr Hugo Stinnes is one of the representatives, and by influential banks, the company has practically realised the delivery of energy from the mouth of the pit, and has endeavoured to create a vast monopoly in the rich industrial district of the west of Germany. At the bank of one of the pits at Essen a large power station has been built, and is already equipped with, among other plant, two 5,000-H.P. steam turbines, while two others of the same size are on order. A second station is nearly finished at the bank of the Wiendahlsbank pit at Kruckel, and the supply of electricity will be commenced early next year. The combined capacity of these two works will be 55,000 H.P., and reserve power will be available from allied undertakings. At present the company has a high pressure network extending over an enormous area, transformer stations being arranged at various places. It appears, however, that while the company has sought to provide equipment to meet all possible demands, difficulties have arisen from third parties. It was endeavoured to cope with the whole of the Rhenish-Westphalian district from a few power stations on a uniform principle, and in order to accomplish this object, it was necessary to secure the co-operation of the local authorities. At first the latter manifested a disposition to approve the scheme, but later on difficulties arose, with the result that the supply of the eastern portion of the area is being threatened by four competing works at the present time. This will have the effect, on account of the disadvantages of a war of competition, of compelling the four rival works to restrict themselves to the thickly populated and more favourable area, whereas a uniform undertaking would have also included the less populous and country districts within its sphere of activity. These observations are extracted from the report for 1905-6 of the Rhenish-Westphalian Electricity Works Co., and they refer to prospective competition on the part of works projected or decided upon by the combination of groups of local authorities which are apprehensive of the establishment of a gigantic monopoly in that part of Germany. The company, which has a combined share and loan capital of £2,500,000, already has customers representing 21,000 KW., and the sales were 22,700,000 KW.-hours in 1905-6, as compared with 11,600,000 KW.-hours in the previous year. A dividend at the rate of 6 per cent. has just been declared on the paid-up capital, as against nothing in the previous year, the gross surplus having been £70,290, as contrasted with £31,642 in 1904-5.

Atmospheric Nitrogen.—A development is reported to be taking place in connection with the Norsk Hydro-Elektrisk Kwälstof Aktieselskabet (Norwegian Birkeland Saltpetre Co.), which was formed about a year ago for the manufacture of nitrate from nitrogen obtained from the atmosphere according to the system devised by Prof. Birkeland. It appears that the German company known as the Badische Anilin und Sodafabrik, of Ludwigshafen, has made independent experiments in respect of the collection of nitrate in the same direction, and has acquired patents of its own which are said to supplement those of the Norwegian company. As manufacture on a common basis has now been arranged between the two parties, the Norwegian company has decided to make an increase in its share capital, which at present amounts to 3,000,000 crowns in ordinary shares and 4,000,000 crowns in preference shares. The augumentation will take the form of an emission of 13,000,000 crowns in ordinary shares, of which the Germany company in question will probably subscribe one half, although as the details have yet to be finally settled, some modification of the proportion of shares to be allotted may be made. It is stated that the new process or improvement on the Birkeland method has been tested by Herr Schlesing, member of the Institut de France, and by Herr Otto Witt, of the Charlottenburg Technical High School. The erection of the Norgegian company's works is in progress. At present the company has 2,500 H.P. at its disposal, and an installation of 30,000 H.P. is being established. It is proposed with the augmented capital to acquire two other waterfalls which will be able to yield 130,000 H.P. combined, and other water powers are declared to be available for further extensions.

Electric Cabs in Berlin.—The first day of the New Year will witness the coming into force in Berlin of a new scale of fares which has just been approved by the police authorities for the horse-drawn and petrol and electric cabs of the taxameter class, and which will impart a special stimulus to the use of the electromobiles. It appears that the initial or basis fare for the horse cabs has been increased to 70 pfennigs (8·4d.) for the permitted distance without extra payment, that for petrol cabs has been raised from 50 pfennigs (6d.) to 70 pfennigs and that for the electric cabs remains at 80 pfennigs (9·6d.). In the case of both petrol and electric cabs, however, the maximum distance covered by these fares has been reduced to 600 metres, and to 300 metres for each extra length of route allowed to be traversed for an additional charge of 10 pfennigs (1½d.) per section. The basis fares are, consequently, as follows:—

Taxameter horse-cab ...	...	70 pf. = 8·4d.
,, petrol cab...	...	70 pf. = 8·4d.
,, electric cab	...	80 pf. = 9·6d.

If a comparison is made between the old and new scales of fares for daily service in the case of five different routes, ranging from a distance of 1½ miles for the shortest to 4½ for the longest, it is found that the horse-cabs under the revised charges show an increase of 2½d. on each of the five routes; the petrol cab fares have advanced 4·8d. on the shortest to 8·4d. on the longest, and the fares for the electromobiles have risen 2½d. on the shortest and 6d. on the longest route mentioned. In the case of night services, the horse and petrol cabs are equal, whilst the electric cabs are only 10 pfennigs (1½d.) dearer than the two former for any one of the five journeys concerned.

It is believed that the special concessions accorded to the electric cabs will cause the use of them to be largely extended. The manager of a Berlin electric cab company states that a favourable opportunity for existence now arises for this type of cab. The public, he declares, does not consider what an electric cab costs in repairs, the rubber tires in particular continuing to be the source of sorrow of a cab company. When a paid-for journey has been accomplished the cab has to be driven to the nearest automobile rank, and this costs as much as the journey with a passenger. At present an electric cab has to travel from 99 to 105 miles in day and night work in order to earn £3—that is to say, as much as is necessary for maintenance, repairs and wages; but under the new scale of fares a cab will be able to earn from £3 10s. to £3 15s. with the same mileage run.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Engineers. — On Wednesday last week at the Empress Hotel, Sunderland, a company of about 90 members and friends of the Electricity Works Department dined together. Mr. J. F. C. SNELL was the guest of the evening, the occasion being his last appearance among the staff in his official capacity. Mr. E. White, station superintendent, presided, and after proposing the health of their retiring chief, he called upon Mr. T. Nichols, mains foreman, to make a presentation of a gold watch to Mr. Snell. Subsequently a silver-plated toilet set was presented for Mrs. Snell. Mr. Snell, in acknowledging the gifts, expressed his regret at parting from so many of his real and long-established friends and colleagues. He also alluded to the number of improvers and others of the department, who had left Sunderland to take up better positions under other municipalities or companies elsewhere, and said it was quite a pleasure to him when visiting other towns to meet some of his old Sunderland juniors and others holding very responsible positions. He alluded to the good qualities of his successor, and urged the workmen to give to Mr. BLACKMAN the same unswerving loyalty as they had given to him (Mr. Snell) in the past.

Mr. A. REDFERN has been appointed chief assistant to the Darlington Corporation Electricity and Tramways Department.

Tramway Officials.—There has been another change in the chairmanship of the Lancaster Corporation Electric Tramways Committee. Councillor JACKSON, having been appointed to the chairmanship of the Streets Committee, has resigned, and Col. J. ALLEN is the new chairman.

General.—On the occasion of his leaving Birmingham on the 19th inst., Mr. J. D. MORRISON, of the British Prometheus Co., Ltd., was presented with a smoking cabinet by his colleagues on the staff. Mr. Edwards, in making the presentation, expressed the esteem in which Mr. Morrison was held, and regretted his departure, and Mr. Westwood, on behalf of the works staff, spoke of the harmonious working arrangements which had always existed. Mr. Morrison suitably acknowledged the gift.

Cardiff Board of Guardians has appointed Mr. GORDON HOLMES, of Fairfield, as electrician at the workhouse.

Mr. R. BORLASE MATTHEWS, Wh. Ex., A.M.I.C.E. (author of our series of articles on the "Commercial Development of Electricity Supply Undertakings,") has commenced practice at 9, Cambrian Place, Swansea, as a consulting electrical engineer. Mr. Matthews is prepared to give expert advice upon power work and the application of electricity to industrial purposes, and is also making a speciality of the technical and general organisation of commercial sales or new-business-getting departments for electricity supply undertakings. As some of our readers are aware, Mr. Matthews was very successful in this connection during the time he spent in the United States, and is very well acquainted with English conditions and requirements.

NEW COMPANIES REGISTERED.

Mansfield and District Tramways, Ltd. (91,130).—This company was registered on December 7th, with a capital of £130,000 in £1 shares (80,000 6 per cent. cumulative preference), to construct, purchase, lease or otherwise acquire any light railways, electric or other tramways, electric light and power works and the like, in particular to take over the undertaking and all or part of the share capital, debentures and mortgages of the Mansfield and District Light Railway Co., with the benefit of the Mansfield and District Light Railways Order, 1901, and any other order affecting the said undertaking, and with a view thereto to adopt an agreement with the Municipal and General Properties Syndicate, Ltd. The first subscribers (each with one ordinary share) are:—H. E. Gibbins, 4, Georgette Place, West Bromwich, clerk; A. R. G. Abbot, 4, Park Road, Wandsworth Common, S.W., accountant; H. W. Stirling, 3, Vanbrugh Park Road, Blackheath, S.E., gentleman; P. Wild, 37, Trafalgar Road, Greenwich, S.E., clerk; A. H. Witham, 11, Holland Road, Brixton, S.W., accountant; W. L. Cox, 5, Royal Avenue, Sloane Square, S.W., accountant; and A. D. Buddle, 20, Stondon Park, Honor Oak Park, S.E., clerk. Minimum cash subscription, 10 per cent. of the shares offered to the public. The number of directors is not to be less than three or more than seven; the first are A. R. Holland, Leeson's, Chislehurst (late vice-chairman of the Mansfield and District Light Railway Co.); W. J. Chadburn, Mansfield (managing partner of the Mansfield Brewery Co.); A. H. Beatty, F.C.I.S., 4, Clement's Inn, W.C.; and Geo. Balfour, M.I.E.E., A.M.I.M.E., The Elms, Bromley, Kent; qualification (after first three months), £300; remuneration, £75 each per annum, and £25 extra for the chairman.

City of Oxford Electric Tramways, Ltd. (91,106).—This company was registered on December 6th, with a capital of £150,000 in £1 shares, to acquire or construct, equip, maintain and turn to account tramways, light and other railways, telegraph and telephone lines and the like, and to carry on the business of electricians, engineers, contractors, manufacturers of rolling stock and electrical machinery, suppliers of electricity, &c. The first subscribers (each with one share) are:—C. T. Lissenden, 24, Arica Road, Brockley, S.E., clerk; P. R. Reeves, 42, Crediton Road, Kensal Rise, N.W., shorthand writer; R. Bott, 36, Southcote Road, Woodside, S.E., gentleman; R. J. Hawkins, 10, Soudan Road, Battersea Park, S.W., clerk; A. W. N. Stuart, 9, Barnsbury Park, N., accountant; S. Jordan, 115, Elm Park Mansions, Chelsea, S.W., gentleman; and W. J. McNelly, 15, Walter Street, Stepney, E., gentleman. No initial public issue. The number of directors is not to be less than three or more than seven; the subscribers are to appoint the first; qualification, £250; remuneration (except any salaried managing director), £200 each per annum and £100 extra for the chairman. Registered office, Queen Anne's Chambers, Westminster.

Indian and Colonial Development Co., Ltd. (91,113).—This company was registered on December 6th, with a capital of £1,000 in £1 shares, to apply for, acquire and deal with orders, concessions, grants, powers, or covenants, to produce, acquire, utilise, store, supply or otherwise dispose of electric current, and to carry on the business of proprietors of tramways, railways, motors, omnibuses and conveyances, suppliers of electric light, contractors, financiers, agents, &c. The first subscribers (each with one share) are:—W. G. Clegg, 56, Hubert Grove, Clapham, S.W., clerk; W. B. Swain, 189, Northumberland Park, Tottenham, clerk; G. Aylwen, 57, Howard's Lane, Putney, gentleman; J. R. S. Lake, Alexandra Road, Watford, gentleman: A. G. Greig, 1, King's Bench Walk, Temple, E.C., gentleman: E. J. W. Jendwine, The Cedars, Datchet, gentleman; and R. Walgrove, 20, Bryanston Street, W., gentleman. No initial public issue. The number of directors is not to be less than three or more than five: the subscribers are to appoint the first; qualification £10; remuneration as fixed by the company. Registered offices, Worcester House, Walbrook, E.C.

S. H. Justin & Co., Ltd. (91,133).—This company was registered on December 7th, with a capital of £1,000 in £1 shares, to carry on the business of cycle and motor manufacturers, engineers and contractors, electricians, carriers of passengers and goods, constructors of tramways, carriages, trucks and locomotives, manufacturers of accumulators and dynamos, &c., and to adopt an agreement with S. H. Justin for the acquisition of the business carried on by him. The first subscribers (each with one share) are:—S. H. Justin, 43, Stokes Croft, Bristol, cycle engineer; Mrs. A. M. Justin, 27, Surrey Road, Bristol; A. G. Justin, 14, Graham Road, Bristol, storekeeper; Mrs. M. A. Justin, 29, Avondale Road, Bristol; W. J. Justin, 6, Marsh Road, Bristol; E. G. Justin, 32, Chaplin Road, Bristol, builder; and Mrs. M. Justin, 14, Graham Road, Bristol. No initial public issue. The number of directors is not to be more than five; the first are not named.

Pearson, Sons & Co., Ltd. (6,359).—This company was registered in Edinburgh on December 6th, with a capital of £6,000 in £10 shares, to carry on the business of engineers, iron and brassfounders, makers of steel and iron bridges, gas and electric light apparatus manufacturers, electrical engineers, &c. The first subscribers (each with one share) are:—J. S. Pearson, 165, St. Andrew Road, Glasgow, engineer; F. S. Pearson, 165, St. Andrew Road, Glasgow, engineer; H. G. Pearson, 165, St. Andrew Road, Glasgow, engineer; R. Rowell, 165, St. Andrew Road, Glasgow, engineer; H. Swinden, 44½, Percy Street, Newcastle, cutter; H. S. Swinden, 44½, Percy Street, Newcastle, cutter; and C. Proutt, 95, West View, Newcastle, clerk. The number of directors is not to be less than three or more than five; the first are J. S. Pearson, F. S. Pearson, H. G. Pearson, and R. H. Rowell: qualification, 10 shares; remuneration as fixed by the company. Registered office, 107, Cathcart Street, Kingston, Glasgow.

Aluminium Syndicate, Ltd. (91,103).—This company was registered on December 6th, with a capital of £10,000 in £1 shares, to deal with and turn to account properties and rights in England and elsewhere for the establishment of works for the manufacture or rendering merchantable of aluminium or any metals or substances utilised in connection therewith, to promote companies, to supply electricity, &c. The first subscribers (each with one share) are:—F. R. Mills, 14, St. Helen's Place, E.C., solicitor; E. Edwards, 9, Rona Road, Gospel Oak, N.W., clerk; W. W. Roper, 14, St. Helen's Place, E.C., clerk; H. P. Dakin, 130, Holmesdale Road, South Norwood, S.E., clerk; R. J. Muggleton, 135, Rosebery Avenue, Manor Park, clerk; R. G. Cheshire, 14, St. Helen's Place, E.C., clerk; and H. M. Cohen, 14, St. Helen's place, E.C., solicitor. No initial public issue. The number of directors is not to be more than five: the first directors are not named.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Gell Telegraphic Appliances Syndicate, Ltd. (78,405).—This company's annual return, made up to January 14th, was filed on March 28th, when the entire capital of £30,000 in £1 shares had been taken up; 10s. per share has been called up on 15,000 shares and £7,857 10s. has been received, including £337 10s. paid on 1,600 forfeited shares; £7,500 is considered as paid on the remaining 15,000 shares. Mortgages and charges: Nil. The capital was increased to £40,000 in £1 shares on September 8th, and 2,350 of the new shares were allotted, subject to payment in cash, on October 9th.

Electrolytic Alkali Co., Ltd. (64,360).—This company's annual return was filed on November 17th, when 99,965 preference and 201,904 ordinary shares had been taken up out of a nominal capital of £500,000, in 200,000 preference and 500,000 ordinary shares of £1 each; £226,909 10s. has been received, including £131 15s. paid on 35 preference and 314 ordinary shares forfeited; £1 5s. remain in arrears; £7,500 is considered as paid. Mortgages and charges: £21,150 first mortgage debentures.

New Phonopore Telephone Co., Ltd. (44,654).—This company's annual return was filed on November 5th, when 5,211 ordinary and 1,000 founders' shares had been taken up out of a nominal capital of £10,000, in 1,000 founders' and 9,000 ordinary shares of £1 each; £1 per share has been called up on 5,211 ordinary and £5,211 has been received; £1,000 is considered as paid on the founders. Mortgages and charges: Nil.

York Electrical Co., Ltd. (77,119).—This company's annual return was filed on November 24th, when 3,100 shares had been taken up out of a nominal capital of £5,000 in £1 shares; £1 per share has been called up on 1,100, resulting in the receipt of £1,100; 2,000 shares are considered as fully paid. Mortgages and charges: Nil.

Nalder Bros. & Thompson, Ltd. (62,214).—This company's annual return was filed on October 24th, when 8,256 preference and 11,125 ordinary shares had been taken up out of a nominal capital of £22,500 in 10,000 preference and 12,500 ordinary shares of £1 each; £1 per share has been called up on 8,256 preference and 1,125 ordinary, resulting in the receipt of £9,381; 10,000 ordinary are considered as fully paid. Mortgages and charges: Nil.

Consolidated Supply Co., Ltd., electrical engineers, Canonbury (85,838).—Issue on November 7th of £1,000 5 per cent. debentures, part of series created July 18th, 1906, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Consolidated Electrical Co., Ltd., Broad Street House, E.C. No trustees. Previously issued of same series: £11,500.

General International Wireless Telegraph and Telephone Co., Ltd., London (75,277).—A debenture dated November 26th, 1906, to secure £30 and any further advances up to £500, charged on the patents, rights and benefits comprised in a mortgage dated November 28th, 1905, has been registered. Holder:—F. W. Corby, 1-4, Green Dragon Court, St. Andrew's Hill, E.C.

Limia Co., Ltd. (Electric power suppliers, &c., Spain) (87,734) Issue on November 26th of £2,000 6 per cent. debentures, part of series created April 11th, 1906, to secure £200,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. No previous issue of same series.

Electric Safety Appliances Co., Ltd. (London) (83,864).—Issue on November 14th of £800 5 per cent. debentures, part of series created November 7th, 1906, to secure £1,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. No previous issue of same series.

Easton Lift Co., Ltd. (81,115).—This company's annual return was filed on October 9th, when the entire capital of £25,000 in £1 shares (5,000 "A" preference, 5,000 "B" preference and 15,000 ordinary) had been taken up. £1 per share has been called up on each of the "A" and "B" preference and £10,000 has been received. 15,000 ordinary shares are considered as fully paid. Mortgages and charges: nil.

Electrolytic Alkali Co., Ltd., Middlewich.—Issue on November 15th of £2,200 4½ per cent. first mortgage debentures, part of series created July 9th, 1904, to secure £50,000, charged on the company's undertaking and property, including uncalled capital. Trustees: Liverpool Mortgage Insurance Co., Ltd., 6, Castle Street, Liverpool. Previously issued of same series: £21,150.

Frederick Braby & Co., Ltd. (2,537c). — This company's annual return, made up to August 30th, was filed on October 1st. 16,480 ordinary and 2,500 preference shares have been taken up out of a nominal capital of £225,000 in 20,000 ordinary and 2,500 preference shares of £10 each. £9 per share has been called up on 13,230 ordinary, £5 per share on 3,250 ordinary and £10 per share on 2,500 preference. £160,340 has been paid, including £20 received in respect of five forfeited shares. £13,000 is considered as paid, being £4 per share on 3,250 ordinary shares. Mortgages and charges: £42,225.

Edison-Bell Consolidated Phonograph Co., Ltd. (72,045).—This company's annual return was filed on October 30th, when the entire capital of £27,500 in 2,500 ordinary and 25,000 preference shares of £1 each had been taken up. All the shares are considered as fully paid. Mortgages and charges: £111,002.

Gosport and Alverstoke Electric Lighting Co., Ltd. (82,693).—This company's annual return was filed on October 30th, when 110 shares had been taken up out of a nominal capital of £5,000 in 500 shares of £10 each; £1 per share has been called up, and £110 has been received. Mortgages and charges: Nil.

CITY NOTES.

Buenos Ayres Grand National Tramways Co., Ltd.

The directors' report for the year ending March 31st, 1906, says that the gross receipts of the lines operated by the Buenos Ayres Grand National Tramways Co., Ltd. (consisting of the lines of this company and those of the Buenos Ayres New Tramways Co., Ltd.), have amounted to £251,283, as compared with £216,037 for the previous year. The working expenses amounted to £191,580, as compared with £162,189. The net receipts amounted to £59,704, as compared with £53,848. The Grand National Co.'s share of the above net receipts under the agreement has amounted to £45,557, as compared with £40,386 for the previous year. After payment of London administration expenses, interest on debentures, &c., there remains a balance of £6,385, from which the sum of £2,150 has been transferred to debenture reserve funds and £3,726 to income bondholders' interest account, leaving £509 to be carried to the contingency fund. The amount at the credit of income bonds interest account is £3,830. It is proposed to pay interest at the rate of 5 per cent. per annum for the year on these bonds; this will absorb £3,726, leaving £104 to be carried forward. Satisfactory progress has been made with the work of converting, for electric operation, the joint system, consisting of the lines of this company and those of the Buenos Ayres New Tramways Co., Ltd., and at November 30th, 1906, there had been converted a total length of 69½ miles. No comparative statement showing the benefits derived from electric traction can be made upon the basis of the accounts to March 31st, 1906, owing to the very small proportion of electric traction which was in operation during the year ended on that date, and the high cost of operating the remaining horse traction due to disturbance by the reconstruction works; but it may be mentioned that, for the first six months of the current financial year (*i.e.*, from April 1st to September 30th, 1906) the net receipts derived from operating the joint system showed an increase of over 100 per cent. as compared with the corresponding months of 1905. The Bill promoted by the company in the last session of Parliament for the rearrangement of the company's capital account was duly passed, and became law on July 20th, 1906. The date to which the accounts are made up being March 31st, 1906, the capital has to be stated as it existed at that date. An appendix is, however, annexed to the report, showing the capital of the company as it now stands in view of the alterations made by company's Act of Parliament.

Underground Electric Railways Co., Ltd.

The fourth annual meeting of this company was held on Friday last at Hamilton House, E.C. Sir Edgar Speyer presided.

The Chairman, in moving the adoption of the report (see Electrical Review, December 21st) said that since the date of their last meeting they had lost by death their chairman, Mr. Charles T. Yerkes. There was little to add to the report, except to say that it was very gratifying that within about six months the Underground Co. would be out of the construction period and would have completed the system of tube railways, which it had undertaken to construct, and there was every reason to believe that this construction would have been finished at a cost not above the estimates framed. That result was highly satisfactory, and reflected great credit on the engineers, for it was a rare occurrence in construction business that the estimates were not exceeded. Unfortunately, the satisfactory result of that part of the company's transactions has been counteracted by the continuance of unfavourable money and stock markets. The cost of financing that great undertaking had been consequently much heavier than could have been anticipated. The rate of interest for loans, as was well known, had been on a constantly progressive scale, and the prices of securities had been adversely affected generally. Under the circumstances the company considered it necessary to make a call in August last of £2 10s. per share, and if these unfavourable money conditions continued, it would probably be necessary to call up the entire capital. The construction work, as pointed out, was nearly completed, and the company was well provided with means to raise such amount of money as was necessary to finish the works still in hand. The company would have over £1,000,000 of debentures and a large amount of stocks of the various companies in its treasury. It had, further, a very valuable asset in the Chelsea power house, the importance of which was being more generally recognised now, and the value of which was very considerable. The capacity of that power house was very great, and the surplus amount of power that could be produced could be disposed of to outside concerns. A beginning had been made by supplying the L.C.C. Embankment tramways with electric current. Let him again emphasise that before completion of the works, and before the new lines had been running for at least twelve months as a unit, it was both premature and impossible to express any opinion as to the earning capacity of the system, but the board had every confidence that when the whole undertaking had been completed and was in full working, the traffic and revenue would steadily develop and increase. The policy of the board would be to encourage consolidation and co-operation, not only amongst the component parts of their system, but co-operation also with other companies and municipal authorities who had the same aim as the Underground Co., viz., to improve the traffic facilities of London.

Lord George Hamilton seconded the motion, and the report was adopted.

Douglas Southern Electric Tramways, Ltd.

The directors' report for the year ending October 31st, 1906, says:—"The company's season consisted this year of 121 days, as against 114 days last season, whilst the mileage run is 34,133·22, as against 33,313·59 last year. The season has been a record one, and our line has received its share of patronage. The passengers carried were 229,316, against 210,298 last year, and it is a pleasure to report once more a total absence of accident to passengers, plant or rolling stock. The total receipts for the season are £5,542, as against £5,107 last year." After deducting certain items, there is a total of £4,357, as against £4,257 last year. The net profit for the year is £2,138, as against £1,745 last year, which, added to £219 balance from last year, gives a total disposable balance of £2,356. The directors recommend a full dividend of 7 per cent. upon the preference shares which will absorb £1,818, and that 1½ per cent. be paid upon the ordinary shares, leaving a balance to carry forward of £345. With the exception of the sum of £25 owing to sundry creditors, there are no mortgages, debentures, or other incumbrances whatever upon the company's property. The whole of the buildings, rolling stock, boilers, engines, electric equipment, and permanent way, have been kept in the very highest state of efficiency out of revenue.

Burmah Electric Tramways and Lighting Co., Ltd.

—The report for the year ended July 31st, records no improvements in the accounts, as compared with those of the previous year. The total surplus of £3,543 is to be carried forward. The outbreak of plague in Mandalay had not, even now, quite disappeared, and the improvement shown during the first six months was entirely lost during the latter half of the year 1905-6, with the result that the company has done little more than mark time. The directors are sorry to say that in spite of their efforts they have as yet been unable to reduce the great expense of fuel. They are arranging to make a short extension from one of the stations of the Burmah Railway to the Pagoda, which, it is believed, will help the traffic materially. The directors look forward with some confidence to an improved position before the termination of 1906-7. The meeting of the company was held in London on the 19th inst., and the report was adopted.

France.—La Compagnie Générale d'Electricité, of Paris, reports a profit of £73,056 for the last financial year, as compared with £60,642 in the preceding 12 months.

Liverpool Electric Cable Co., Ltd.—At the annual general meeting held at Liverpool on Friday, 21st inst., a dividend of 7½ per cent. was declared, payable at once. We understand that the company's business during the past year has so increased that they have had to nearly double their plant.

W. & T. Avery, Ltd.—Interim dividend at the rate of 5 per cent. per annum on the ordinary shares for the half-year ended September 30th.

New Quay Electric Light & Power Co., Ltd.—In a circular to its shareholders the company states that the annual general meeting will be held on 28th inst. (to-day), but that no accounts will be presented, the meeting being formal only. The number of customers which the company have secured has exceeded their expectations. The houses already connected, and being connected, are estimated to produce a revenue more than sufficient to pay working expenses. The directors are of opinion that the success of the company even at this early stage is assured.

Stocks and Shares.—Owing to the interruption of business on the Stock Exchange and elsewhere for the Christmas holidays, we have this week omitted our list of Electrical Stocks and Shares, and our weekly article relating thereto. The same remark applies to our Table of Market Quotations.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING NOVEMBER, 1906.

Few of our readers will be inclined to quarrel with the November returns of electrical business recorded below; the exports and re-exports of electrical goods which mainly concern the British trader, having touched the highest point recorded during the past two years.

The total of the exports at £197,486 is some £50,000 in excess of the October returns, and £87,000 ahead of the total for November, 1905; the re-exports at £24,451 compare with £16,000 a month ago, and £9,591, the amount recorded in November last year.

The imports, although still at a high level, viz., £154,269, are some £13,000 less than in October, and compare with £131,194 in November, 1905. Specially notable is the improvement in the electrical cable and machinery exports, some £7,000 worth of tramway material figuring among the items of the month. An unusual feature of this section is the export of £4,000 worth of electrical machinery to Germany. In regard to the re-exports from this country, some £10,000 worth of telephones and £8,000 worth of electrical machinery are included in the high total of the month.

No special feature is noticeable in the case of the imports, which, on the whole, show reduced values; the importation value of telephonic apparatus remains steady at £30,000 approx., contributed, as usual, by Belgium and Sweden.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.*

Country receiving exports and importing.	Electrical goods and appliances.	Electrical cable.	Electric lighting fittings and accessories.	Electric lamps.	Electric meters and instruments.	Electric machinery.	Batteries and accumulators.	Carbons.	Telegraph and telephone material, and electric bells.	Electrically-driven machinery.	Tramways apparatus and materials.
	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark and Dan.	277	27	244	54	33	2,729	...	...	69	135	...
West Indies											
Germany	222	412	35	27	18	4,132	47	...	...	...	...
Netherlands	3	450	466	2	4	475	8	...	...	135	...
Belgium	217	46	21	18	57	135	...	7	499	21	...
France	112	8	36	...	14	594	140	...	...	20	...
Portugal, Madeira and Portuguese Africa	516	405	207	324	108	608	5	...	6	...	...
Spain and Canary Isles	110	35	277	...	...	1,180	...	...	...	91	...
Italy and Austria-Hungary	7	...	13	...	1,272	343	20	...	11	50	...
Greece, Roumania and Turkey	135	...	...	...	18	288	...	...	...	315	...
Egypt and Tunis	1,216	5	354	47	14	1,079	47	...	7	2,635	...
China and Siam	206	2,204	1,566	74	18	1,886	...	...	69	33	...
Japan	63	13,713	36	224	1,264	9,302	...	...	...	6,682	...
U.S.A., Philippines and Cuba	...	...	75	762	15	4,439	35	...	...	...	...
Mexico, Colombia and Gautemala	32	70	157	4	...	207	...	...	64	2,310	...
Peru, Uruguay and Paraguay	92	594	13	9	...	...	...	...	40	...	...
Chili	473	266	259	227	38	597	21	...	676	24	...
Brazil	551	...	64	5	274	320	4,956	...	12	...	5,887
Argentine	1,696	4,765	296	209	44	7,343	184	...	654	3,303	...
Channel Isles, Gibraltar and Malta	973	2,699	139	483	31	951	58	...	3	29	...
British West Africa	27	...	2	...	...	159	65	...	...	...	...
Cape of Good Hope	859	265	324	105	27	2,311	109	...	9	10	...
Natal	741	872	477	273	...	2,617	372	...	...	539	...
Zanzibar, Brit. East Africa, Mauritius and Aden	113	14	67	23	87	...	3	...	48	28	...
India	1,373	18,345	1,069	484	1,000	6,376	59	155	52	1,962	794
Burmah	384	611	59	50	22	239	27	...	3	9	24
Ceylon	78	12	42	13	44	52	17	1	1	...	...
Straits Settlements and Fed. Malay States	370	267	167	413	40	234	...	...	...	177	...
Hong Kong	122	46	309	215	...	33	...	...	3	4,517	...
West Australia	487	746	174	281	...	915	525	...	31	224	...
South Australia	15	259	118	...	52	72	...	...	...	...	...
Victoria	219	10,168	392	169	356	1,510	2	11	...	...	...
New South Wales	1,828	2,306	483	720	71	3,608	82	...	148	37	...
Queensland	141	...	...	...	100	1,517	...	...	...	...	...
Tasmania	112	...	6	...	...	...	...	...	...	...	...
New Zealand	1,042	5,629	391	117	341	1,150	64	7	...	...	...
Canada and Newfoundland	87	51	201	36	65	528	...	25	...	...	...
British West Indies, and British Guiana	122	...	97	...	64	93	35	...	65	...	...
Total, £	15,021	65,290	8,636	5,368	5,491	58,122	6,891	206	2,470	23,286	6,705

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

	£	£	£	£	£	£	£	£	£	£	£
Russia, Norway, Sweden and Denmark	96	322	...	...	84	3,004	55	8	10,624	...	...
Holland	467	8,008	1,337	12,141	339	1,647	863	4,541	679	...	...
Germany	3,230	12,263	1,212	2,654	85	7,238	1,993	2,178	1,172	...	...
Belgium	1,401	5,143	1,836	4,880	304	2,990	333	1,711	13,507	1,150	...
France	424	3,486	1,104	2,217	1,137	2,795	808	2,940	4,293	65	...
United States	1,618	1,869	1,226	176	90	17,608	71	7	44	2,696	...
Canada	...	50	...	...	...	20	...	...	...	...	...
Total, £	7,236	31,141	6,715	22,068	2,039	35,302	4,123	11,385	30,319	3,911	...

Additional Import: Portugal, electrical machinery, £30.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

	£	£	£	£	£	£	£	£	£	£	£
Various countries, mainly as above	3,340	1,400	908	156	9	7,834	85	31	10,475	211	...

Total Exports: £197,486

Total Re-Exports: £24,451

Total Imports: £154,269

Note.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

* This section does not include telegraph cables and apparatus.

LONG SPANS FOR POWER TRANSMISSION LINES.

By T. L. KOLKIN.

In my article on "Power Transmission Lines" in the Electrical Review for September 14th and 21st, 1906, I made a rough comparison between the cost of iron and wooden poles for transmission lines. It was pointed out that if spans of, say, 50—60 m. were used, the former would, under ordinary conditions in this country, turn out just as cheap as, if not cheaper than, wooden poles.

In the following we will investigate which length of span will make the cheapest pole line for the various sizes of wires. The longer the span is, the fewer poles are required per unit of length of line; at the same time the poles must be stronger and longer on account of the heavier weight to carry, and on account of the greater sag.

The cost of a pole line is made up of the cost of poles, cross-arms and insulators, together with the cost of transport, delivery to site, and erection of the same. The main item in the above is the cost of poles, the amount of which is practically in proportion to the weight of the poles. The cost of transport, delivery to site and erection is also nearly in proportion to the weight of the poles, and consequently to the cost of the latter.

The cost of cross-arms and insulators is a comparatively small item. The longer the span is, the stronger the cross-arms and insulators must be, and no great error will be made

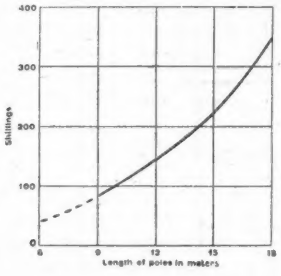


Fig. 1.

in assuming that the cost of these, together with delivery to site and erection, will increase in the same proportion as the poles. The whole problem resolves itself into finding the minimum weight, or cost, of poles required per unit of length of line, say, per km.

Fig. 1 shows the approximate cost in this country of lattice poles of various lengths, and for a load of 450 kg. (1,000 lb.) with a coefficient of safety of 5. This curve practically follows the following formula:—

$$y = a\,x + b\,x^2 \quad \ldots \quad \ldots \quad (1)$$

where y = cost in shillings,
x = length of pole in m.,
a = ·5,
b = 1.

The constants a and b in the above formula would approximately amount to—

For 360 kg. (800 lb.) poles: a = ·4, b = ·9.
For 270 kg. (600 lb.) poles: a = ·3, b = ·7.

The total length of the poles is made up of the length of the part of the pole placed in the ground, the height of the lowest part of the wires above the ground level, the length of the space required for the cross-arms, and the sag.

The last item depends upon the length of the span and strain on the wires, while the three first items are, under ordinary conditions, practically constant for a given transmission line.

We will assume that the sum of these three items amounts to 8 m., so that the total length of the poles will be—

$$l = 8 + s\,(\text{sag})\ \text{in m.}$$

We further know that—

$$s\,(\text{sag}) = \frac{p\,w^2}{8\,\sigma\,s'} = \frac{8{\cdot}9\,w^2}{8{,}000\,\sigma}, \quad \ldots \quad (2)$$

where w = length of span in m.,
σ = strain on wire in kg. per mm².,
s' = section of wire in mm².,
p = weight of wire in kg. per m.,
8·9 = specific weight of copper.

The cost of one pole would thus be—

$$y = a\left(8 + \frac{8{\cdot}9\,w^2}{8{,}000\,\sigma}\right) + b\left(8 + \frac{8{\cdot}9\,w^2}{8{,}000\,\sigma}\right)^2 \text{ in shillings} \quad (3)$$

and the cost of poles per km.—

$$y = \frac{8{,}000\,a}{w} + \frac{8{\cdot}9\,a\,w}{8\,\sigma} + \frac{64{,}000\,b}{w} + \frac{17{\cdot}8\,b\,w}{\sigma} + \frac{8{\cdot}9^2\,b\,w^3}{64{,}000\,\sigma^2}. \quad (4)$$

The actual size of poles to be used as regards strength can only be decided from case to case when the number and size of wires and the local conditions as regards curves and wind

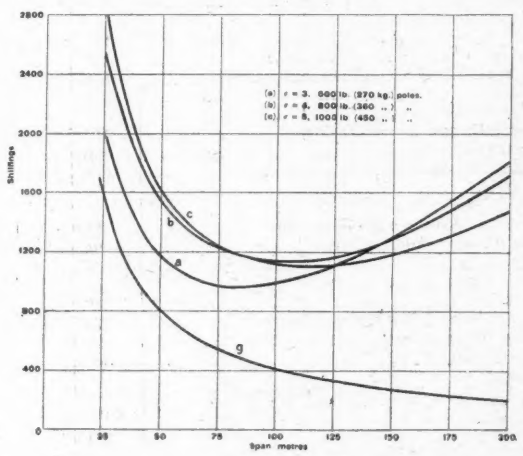


Fig. 2.

pressure are known. We will in the following consider three sizes of wires: s' = 20 mm²., 40 mm². and 80 mm²., and assume that the conditions are such that a pole for 600 lb. load should be used for the 20 mm². wire, a pole for 800 lb. load should be used for the 40 mm². wire, and a pole for 1,000 lb. load should be used for the 80 mm². wire.

We will further assume that poles of the same strength are used for long spans as for short ones. This is, of course, not strictly correct, but this inaccuracy will be dealt with later. The sag for which the length of the poles is to be determined is the maximum sag at highest summer tempera-

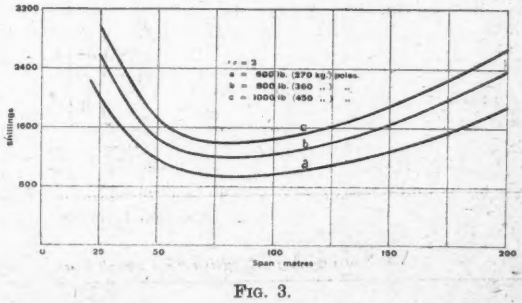


Fig. 3.

ture. Taking the mechanical strength of the wire into consideration, we find on referring to Table V and fig. 3, p. 443 of Electrical Review, September 21st, that σ should not exceed at, say, 30° C.:—

3 kg. for the 20 mm². wire.
4 „ „ 40 „ „
5 „ „ 80 „ „

The cost of poles per km. would thus be (formula 4) for poles of 600 lb. load—

$$y = \frac{2{,}400}{w} + \frac{2{\cdot}67\ w}{8 \times 3} + \frac{44{,}800}{w} + \frac{12{\cdot}46\ w}{3} + \frac{55{\cdot}44\ w^3}{64{,}000 \times 9}.$$

For a span $w = 25$ m. this gives us $y = 1{,}903$ shillings.

In the same way we find the cost for $w = 50$, 100, 150 and 200 m. as well as the corresponding costs for 800 and 1,000-lb. poles. The results are given in Table I, and shown graphically by the curves in fig. 2.

It will be noticed that the length of the "cheapest span" increases with the size of the wire used; for small wires

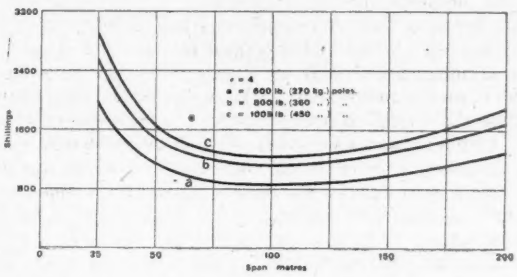


FIG. 4.

this is, for instance, only about 80 m., whereas for larger wires it is about 120 m.

TABLE I.

Size of poles.	Cost of poles per km. at the following spans.					σ in kg.
	25 m.	50 m.	100 m.	150 m.	200 m.	
	Shillings.	Shillings.	Shillings.	Shillings.	Shillings.	
600 lb.	1,994	1,170	995	1,280	1,840	3
800 lb.	2,536	1,530	1,140	1,294	1,720	4
1,000 lb.	2,852	1,590	1,106	1,170	1,475	5

It has been pointed out in this article that for the same size of wires long spans will most likely require stronger poles than short ones. This can now be easily taken into consideration, and it will be understood that it shifts the minimum of the curves further towards the y axis, or in other words, shortens the "cheapest span."

In order to simplify matters, I have drawn up Table II for various sizes of poles and various σ's. The data are shown graphically in curves, figs. 3, 4 and 5:—

TABLE II.

Size of poles.	Cost of poles per km. in shillings at the following spans.					σ in kg.
	25 m.	50 m.	100 m.	150 m.	200 m.	
	Shillings.	Shillings.	Shillings.	Shillings.	Shillings.	
600 lb.	1,994	1,170	995	1,280	1,840	3
800 lb.	2,570	1,505	1,280	1,643	2,389	3
1,000 lb.	2,914	1,701	1,436	1,842	2,666	3
600 lb.	1,971	1,116	856	992	1,319	4
800 lb.	2,536	1,530	1,140	1,294	1,720	4
1,000 lb.	2,874	1,617	1,228	1,408	1,895	4
600 lb.	1,952	1,075	761	822	1,021	5
800 lb.	2,518	1,392	993	1,064	1,342	5
1,000 lb.	2,852	1,590	1,106	1,170	1,475	5
2,000 lb.	4,460	2,397	1,707	1,796	2,453	5

Another point to be taken into consideration in determining the "cheapest span" is the question whether an annual rent has to be paid for the pole line, and if so, how much? The longer the span, the fewer poles are required; consequently the rent is lower, as this is usually reckoned per pole. The ground rent for the poles, capitalised, would, to take an instance, take the shape of Curve G in fig. 2.

There may, of course, be other points also to take into consideration; for instance, the facilities for transportation and delivery to site. The freight on long poles is very high,

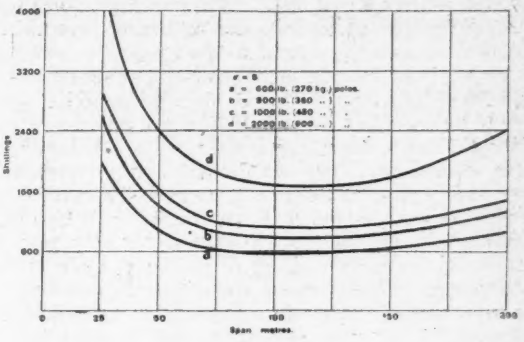


FIG. 5.

unless they are made in two or several lengths. These are, of course, points which can only be taken into consideration in each case, when the local conditions are known.

NOTES ON TURBINE ERECTION AND OPERATION.

THE work in connection with building a large steam turbine, say, of 6,000 H.P., reveals many characteristic and interesting features, the enumeration of which may prove to be of interest to the engineer.

In a turbine having the capacity mentioned above, the revolving spindle is usually built in sections, and the important question of the necessary shrinkage to be allowed for large diameters consequently arises.

It is impossible to formulate any immutable laws of shrinkage; so much depends upon the conditions, namely, thickness and kinds of metal, &c.

During the shrinking together of some large Krupp mild-steel spindle bodies, the following shrinks were adopted with satisfactory results:—

With a diameter of 6 ft. 1 in., a shrinkage of ·150 in. was given.
" " 6 ft. 5 in., " " ·155 in. "
" " 4 ft. 2 in., " " ·100 in. "

The above, which work out to about two-thousandths of an inch shrinkage per inch of diameter, were used on several occasions, with the before-mentioned good results, and will be found to correspond nearly with usual practice, and to possess a good margin of safety.

Just as a large steam engine or turbine cylinder often takes a permanent warp after having been under steam for a time, so the turbine spindle body (particularly with large diameters), after running at full speed under working conditions, is apt to become distorted in a similar manner. It is, therefore, advisable, where possible, to turn large spindle bodies to something slightly above the finished diameter, and before taking the final cut, to run them for several hours at working steam pressure and speed. A reliable method is to run the spindle continuously for, say, 24 hours, examining it at the end of that time for any tendency to elongation, &c. If a distortion has taken place the operation should be repeated, and so on until the permanent set is accomplished, when the finishing cut and grooves may safely be made.

A large turbine spindle, 6 ft. in diameter, recently opened after having been running for several months, was found to have one diameter elongated to the extent of fifteen thousandths of an inch. Taking into consideration the fine running clearances necessary, occurrences of the foregoing nature assume a serious character, and all possible precautions should be taken to prevent them. Here again, however, much depends upon the design, speed and other conditions.

The actual blading of a turbine spindle is a comparatively simple operation, requiring only efficient workmanship to ensure satisfactory results. The method of binding the

ends of a row of blades together, however, is of considerable importance. Probably the most satisfactory method of all, and the one attended with the least number of disastrous results, is to place a continuous shrouding round each row, at the periphery. It has been the practice of some makers to bind the blades together at a point near the periphery with a brass wire running round each row, fitting into a slot cut in each blade, the blades and binding wire being additionally wound with thin copper wire, and afterwards well soldered with german silver or its substitute. Although the latter method is entirely satisfactory from a mechanical standpoint, it possesses certain inherent weaknesses. Chief among these is the fact that the comparatively high temperature necessary to make a good solder joint partially destroys the cohesive property of the metal blade at that particular point, and if we suppose the spindle, under certain abnormal conditions, to whip and cause the spindle blades to rub against the cylinder walls, it is not at all surprising that the short blade ends outside the binding wire occasionally break off and cause interior havoc. Further, the rubbing blades under such conditions would themselves attain an excessively high temperature at their ends, probably sufficient in some cases to cause "hot short." Altogether the soldered binding is unreliable, and it is satisfactory to note that a form of lashing has lately been introduced, requiring no heating of the blades whatever. The wire running round the blades in this case is of a "comma" or similar section, and is notched on either side of each blade, after the latter have been set radially and otherwise.

A few remarks on the balancing of large turbine and generator rotors may not be impertinent at this point. Although fairly accurate results can be obtained with a running balance, in the case of small spindles and armatures, it is a much more difficult matter to obtain similar results with very large and heavy revolving parts. Especially is this so with the type of heavy rotating field much used in alternating-current work. With a good pair of balancing "horses," and an experienced operator, a remarkably accurate balance can be obtained, often requiring no further adjustment. Heavy fields and armatures, however, often require re-balancing after having been on heavy and variable loads for some time, owing to the coils moving slightly. It is, in fact, advisable to re-balance them, even though the running balance of the entire unit has not apparently deteriorated to any great extent.

Heavy unbalanced rotors have their own characteristic idiosyncrasies, and the writer has known of more or less damage being done to bearings, couplings, &c., through this cause, albeit the "resultant" balance of generator and turbine appeared to be extremely good.

Perhaps the best course to adopt (in view of the difficulty experienced in obtaining perfect uniformity or homogeneity in steels) is first to balance each separate ring before shrinking together, by means of a balancing machine: then to take a rolling balance, after the spindle is bladed and finished, and finally test, and, if possible, perfect by means of a running balance, under normal running conditions.

When a new turbine is started up for the first time there are two points in the above connection which require careful note. Assuming the glands to be of the ordinary steam type which, as is well known, consists of bronze rings in the casing, fitting into grooves turned in the spindle, it is possible, nay, highly probable, for very considerable vibration to be set up during the first few hours of running. This is often owing to the tightly fitting gland rings refusing to allow the spindle to revolve on its axis of gravity until a sufficient clearance has been worn. Immediately this has been accomplished the excessive vibration ceases, if the spindle is well balanced. It is always desirable to keep the gland ring clearances down to the smallest dimensions possible; by originally fitting the rings in contact with the spindle, and then running the machine for several hours at constantly increasing speeds, a minimum clearance is worn. To the uninitiated, running up a turbine for the first time, an undue amount of vibration might possibly be attributed to an unbalanced condition of the rotor. Unless, however, the rotor is very badly balanced indeed, no indication of this would be shown until something approaching full speed had been attained. This being so, one would be comparatively safe in assuming apparent bad balance at low speeds to be due to the spindle being restricted to its geometrical axis (which seldom coincides with the true axis of gravity), or some other cause ulterior to the actual balance.

The remaining point to note is excessive vibration at high and low speeds, due to the thrust block having been tightened up too much, probably by a nervous engineer-in-charge.

There are, of course, other means by which vibration while running can be induced, such as, for instance, a slight lack of alignment between the turbine and generator shafts, which often manifests itself at the flexible coupling. Again, many of these couplings have teeth, and unless the latter are well and accurately machined, trouble is apt to arise from that source. Such defects, however, are usually the result of careless workmanship, and require little comment.

The necessity of accurately lining up a large turbo-generator is of supreme importance, and in this connection there are a few points which require care in their operation. For example, the choice of material for the line itself (where the line method is used) has first to be determined. Where the overall distance between the generator outboard and turbine thrust bearings is of considerable length, it is, perhaps, advisable to use a good steel or silver wire, as greater tension can safely be applied (and the amount of "sag" consequently reduced) than in the case of, say, a silken thread. Again, when setting the line to the bore of the cylinder with micrometer gauges, the more definite outline of a metal wire affords the manipulator less possible chance of error than does a twisted line.

After the line is set concentrically and horizontally with the turbine cylinder blades, the next process is usually to adjust the bearings to it. In most large turbines the bearings are all of the spherical adjustable type, vertical and side adjustments being made by either inserting or taking out special liners, the latter usually consisting of sheet steel plates. As all measurements are made previously to the spindle being put in place, it is imperative to apply a downward vertical pressure to each bearing bottom half equal (or greater if possible) to the proportion of the rotor weight carried by it, otherwise a considerable disparity between the actual circumferential clearances, with the rotor in position, and those clearances calculated by means of the gauge, will be noted. Although only of elementary importance, in so far as the principles of erection are concerned, it is surprising how often such points are overlooked, even by experienced engineers.

Too much importance cannot be attached to that portion of the design and construction of turbine bearings dealing with the amount of oil used. In large power stations where the gravity system of forced lubrication is adopted, the consumption of oil per bearing per unit time is, during times of heavy load, failure of pumps, &c., one of the foremost considerations. For example, at one of the largest turbo-generator power stations in existence the oil being used by three machines was reduced 50 per cent. by closing several open-ended bearing liners which had been left in that condition by the erecting engineer. Previously to this being done it was found impossible to maintain a sufficient supply of oil (with the pumps installed) even with only 20 per cent. overload and one extra turbine running. In large plants equipped with the above system of lubrication it is customary, in fact necessary, to place an oil valve on the inlet to each bearing, in addition to the valve on the oil header supplying oil to any particular turbine or group of turbines. The question then arises as to whether it is advisable to positively limit the volume of oil entering each bearing by placing stops in the valve or pipe. From an economical standpoint this course is justified, but experience has proved it to be a somewhat risky proceeding, as such stops, especially when they consist of thin disks with orifices in them, are conducive to accumulations of small quantities of waste, &c., and the aperture once clogged is difficult to clear. It may be said that a valve is not less liable to stoppage in the same way, which is perfectly true. At the same time there are means of temporarily ridding a valve seat of such matter without having to stop the flow of oil through it, even if it be only the elementary trick of screwing the valve hard on to its seat and then suddenly opening it again. In any case, if stops are fitted, it would seem advisable to insert them

on the bearing side of the valve, and thus reduce the possibility of accumulations at the stops.

In view of the foregoing, it is, perhaps, a better policy to leave out reducing disks altogether, and to have a notch on each oil-valve hand-wheel, which can be made to encounter a detent situated so as to supply the minimum quantity of oil. Under emergency the valve can then be opened to the fullest extent.

The question of leakage of steam past the stop and pulsating poppit valves in a steam turbine is of much greater importance than such leakage in a steam engine. Under running conditions on purely friction load, steam leakage past the poppit valve must be reduced to the smallest possible amount. As these valves are usually of the double-beat balanced type, it will be easily conceived that, unless exceptionally good ground joints are obtained, such leakage (in the case of large units) might be the cause of a machine running above the normal speed uncontrolled by the governor. The high vacuum and steam pressure necessary to obtain the best results with this type of prime mover would, in such a case, help to increase the possibilities of such a result. An experience of this kind came within the writer's notice recently. The poppit valve (which was of the common double-seated type) had been ground to its seat when cold. When under steam, the speed of the turbine could not be kept below 15 per cent. above the normal, the point at which the safety governor shut the machine down. On examination it was found that the lineal expansion of the comparatively massive valve seating was much greater than that of the valve itself, and this being so, a considerable leakage occurred through the top seat at no load. The valve was subsequently ground in under a high steam pressure, and nearly all leakage stopped.

With the Parsons type of turbine the method of operating the pulsating poppit valve is an important factor in the governing. It would seem from experience that better results can be obtained with the valve performing short strokes at quick intervals, than when the valve is making long strokes at relatively longer intervals of time. Another reason why the short quick stroke is preferable to the long one is the undoubted fact that with such a method the life of the valve spring (which is compressed at each stroke) is longer, although the total work performed by springs working under both systems of regulation is probably equal over similar periods. The fact remains, however, that with a long stroke any inherent flaws in the steel of the spring manifest themselves sooner, generally in the form of breaks.

Again, it is necessary to have these springs made from the best steel, and it is a curious fact that the better the steel the greater is the liability to the existence of flaws. Where three or four turbines are constantly running in parallel, the fact that one of the poppit valve springs suddenly gave out would probably not be followed by any serious consequences, as the unit in question would immediately take all the possible load it was capable of carrying, leaving the remaining sets to take care of the variations in load. A broken spring in the case of a single unit carrying a small load, however, might cause considerable mischief, due to the rapid rise in speed above the normal. Of course, in such a case the auto-stop or emergency valve would eventually close the machine down entirely, but the possibilities of damage being done in the intervening time are many.

There are usually two distinct parts to this emergency gear—namely, the governor, which operates a small valve, which in turn closes the stop valve (the latter, of course, being quite distinct from the main steam pipe throttle valve), and the stop valve itself which automatically falls at the bidding of the governor. A well-constructed emergency governor, revolving in a closed oil chamber, very seldom fails to act at the critical time. On the other hand, the stop valve has been known to fail in its operation of falling on several occasions. A frequent cause of such failure is sediment carried over from the boilers in the steam, and deposited on the valve body and the piston which lifts the valve. Valves have been known to stick in this way at the end of long runs, even though before starting up they were found (by repeated opening and shutting) to be quite free. Such trouble can only be eliminated by preventing sediment from being carried over at all; even a good strainer often allows sediment to pass it.

One might be forgiven, perhaps, for venturing to suggest that these "vital" parts of a turbine when slightly out of order should not be coaxed into operating by blows with a hammer or spanner, a mode in favour with many unskilled attendants. It should be remembered that a slightly bent spindle in an auto-stop valve makes all the difference between easy and sluggish operation. In fact, where it is positively known that boiler sediment or steam passage stoppages are not the cause of failure to open or shut, it is advisable to take the valve out, and examine the spindle carefully between the centres of the lathe. As the cushioning device on many valves is not always perfect, the valves open and close with more or less of a knock. With highly superheated steam this knocking creates a tendency to stretching of the spindle, and a stretched spindle often means a bent one.

The erection and operation of steam turbines are so closely allied that it is desirable to place the actual construction in the hands of men who have had at least some experience in operating under various conditions.

REVIEWS.

Plant Response, as a Means of Physiological Investigation. By Jagadis Chunder Bose, M.A., D.Sc. London: Longmans, Green & Co. Price 21s.

The object of this book is, as the author's preface announces, to show that the plant may be regarded as a machine, and that its movements in response to external stimuli, though apparently so various, are ultimately reducible to a fundamental unity of reaction. The author considers that there are no movements that in any strict sense may be termed spontaneous or automatic; movements ordinarily known as such being really due to external stimuli previously absorbed by the organism. It can be shown that phenomena as varied and obscure as, for instance, growth and the ascent of the sap are due to the same excitatory reactions, as are seen otherwise exemplified in simple mechanical response. Moreover, still quoting from the preface, there is no physical response given by the most highly organised animal tissue that is not also to be met with in the plant.

It is obvious that a book of 780 pages, with 270 illustrations, is none too ample for a programme so intricate and so varied.

It is proposed in the present notice to set forth some of the more salient points that are dealt with, as far as possible in the author's own words, accepting in their entirety the experimental results.

It is explained in the early part of the book that the distinction between "sensitive" and ordinary plants is an arbitrary one, since all are sensitive—*i.e.*, react to stimulation—the stimulus causes molecular derangement in the tissue of the plant, and it is this fundamental molecular change that finds expression in mechanical and electrical movement. The latter is to be fully dealt with in a forthcoming work—"The Electro-Physiology of Plants." As in the living organism mechanical movement in plants can be recorded in response curves—as the sphygmograph records the pulsatory movements caused by the heart-beat, which vary with the internal condition of the animal—so in plants the author has devised apparatus to record the plant's response to the various stimuli of its environment. There is a well-known plant, the Desmodium Gyrans, or telegraph plant, which shows well-marked pulsatory movements, exhibiting, in the author's opinion, "a more than superficial resemblance" to the movement of the animal heart. This is a papilionaceous plant with trifoliate leaves, the terminal leaflet being large, the two lateral very small. Each of the latter is inserted into a petiole by means of a motile organ known as the *pulvinus*. These lateral leaflets go on continuously executing up and down movements, and the peasant of India, where the plant grows wild on the Gangetic plain, believes that the leaf dances to the clapping of his hands. These lateral leaflets are so slender that there is a

difficulty in attaching to them a recording lever. To overcome this the author has succeeded in devising a recording optical lever. This consists of a light aluminium wire. The two arms of the lever are unequal, and the fulcrum rod rests on frictionless supports of glass or agate. The same rod carries a light mirror; a thread of cocoon silk is stuck to the motile leaflet by a small drop of shellac varnish. The far end of the thread is looped and fixed on any suitable notch on the arm of the lever. The other arm of the lever has a slight sliding counterpoise. By shifting the loop nearer the fulcrum the magnification may be increased. When the moving leaflet makes a downward movement the arm is pulled down, and there is rotation of the fulcrum rod with its attached mirror. A spot of light reflected from the mirror is thus suddenly moved downwards, the magnification being increased according to the distance of the recording surface. For purposes of demonstration a pulsating movement may thus be shown magnified to an amplitude of 1 metre.

Of all the various forms of stimuli the electrical (condenser discharge) is the best. Other means of electrical stimulation, such as a constant current or an induction current, have the disadvantage that they are apt not only to cause more or less permanent changes by polarisation, but also to induce fatigue of the tissue. Excitation takes place at the point where the current leaves the tissue, *i.e.*, at the cathode, thus following the rule of normal reaction in animal tissues.

From records obtained on a fast moving drum with specimens of mimosa, it is found that a latent period of $\frac{24}{100}$ of a second occurs before movement begins; the maximum fall is obtained in the course of two seconds, and the maximum depression continues for about 30 seconds; perfect recovery follows in about six minutes. The present volume deals chiefly with mechanical response. That is to say, when, in the case of the mimosa, for example, the pulvinus is excited, this is owing to the molecular change produced by the stimulus and expulsion of water in the plant tissue, or "negative turgidity variation," and normal mechanical response shown by the fall of the leaf. If suitable electrical connections are made, it will be found that the excitatory change is attended by a strictly concomitant electrical change, the current of response flowing away from the excited point, which, in other words, becomes (galvanometrically) negative, actually, of course, electro-positive. These electrical and mechanical responses are thus expressions of the same thing, viz., molecular disturbance and recovery, concomitant with excitation and recovery from excitation. (There is also an electrical variation of hydrostatic origin due to the mechanical movement of water in the tissue. This is easily distinguishable from the true electrical variation by being galvanometrically positive, and by the fact that it can occur even in dead tissue.)

As already stated, the power of response to stimulus depends upon the molecular condition of the substance, and in this connection it may be added that the author considers that *all* matter is responsive. This irritability of matter, or power of responding to stimulus, it is usual to describe as a "vital" phenomenon, but the author, following the electrical method of investigation, considers he has shown that the power of responding to stimulus, and under certain conditions the arrest of this power, is the characteristic, not of organic matter only, but of all matter, and that in general the various agencies which bring on modification of response in the one case (*e.g.*, fatigue, temperature changes, stimulating or depressing chemical agents, &c.) act in the same way in the other. In support of this view a record is given of the response of metal and its abolition by the action of "poison" (oxalic acid). It might have been interesting (the author must be absolved from responsibility for this suggestion) to obtain response curves of the perhaps "fatigued" girder at Charing Cross.

The author considers that he has established not only the generalisation that there is a fundamental unity of response in the plant and animal, but further, that the transmission of excitation takes place, not as usually supposed by the transmission of a mechanical disturbance, but by propagation of protoplasmic changes, as in the animal. Moreover, if it be the characteristic of the nerve to conduct external excitation, it must be admitted that the plant, like the animal, has a nervous system. The response by contraction, the conduction of the stimulus by protoplasmic change,* the retardation or acceleration of velocity of transmission by cold or warmth respectively, the variation in velocity, according to the strength of the stimulus, its diminution by fatigue, the temporary abolition of conduction by anæsthetics, the fact that the anode blocks the transmission of the excitation, and that the velocity of transmission of excitation in the plant is comparable to that in some animals, all point to the opinion that the plant, like the animal, may be considered to have a nervous system.

The author is bold enough to think that the response of the plant offers a means of tracing the process by which physiological differentiation from simple to complex has taken place under the action of the stimulus itself, and that it also enables us to refer a specific differentiation back to definite forces which have acted asymmetrically on the organism and induced such a change. We are thus able to see that "responsive movements apparently opposite in kind are nevertheless traceable, not to different specific sensibilities, but to a single fundamental sensibility finding different expressions by reason of the induced physiological differentiation." How far this generalisation is to be accepted as a contribution to the theory of evolution is a matter upon which individual opinions will doubtless differ.

To the majority of readers this book will appear chiefly valuable as a record of brilliant and painstaking experimental work. The wide generalisations will not in every instance find full acceptance just yet.

It cannot be denied that Prof. Bose establishes a claim for the plant which seems to place it on another plane in the scale of substances. By virtue of contractility, it responds to stimulation, mechanical, electrical, thermic, chemical, photic, like an animal. Its pulsatory movements bear "more than a superficial" resemblance to the beating of the animal heart; it has a nervous system in the strict sense of the term. Indeed, it is something to be thankful for that the Professor stops short of demonstrating that the individual vegetable is conscious and intelligent, that it knows and judges, and that it can make for higher things.

Seriously speaking, this work represents an enormous stride in our conception of the vegetable kingdom. It throws light on many problems in genetal physiology, and is a welcome contribution to our knowledge of molecular physics. It fully and clearly demonstrates (what, indeed, was not in doubt) that the various energies of the outside world influence the vegetable like the animal organism, and by a more or less similar mechanism; that every phenomenon of which matter is the seat may be reduced to phenomena of transformation having their starting point in some initial energy, and throws light on the interactions that are ever at work between the plant and its environments; it proves that the plant like the animal responds to stimulation. But it does not raise the veil that hides the problem of the origin of that excitability ("vitality") which alone makes response possible. The hidden influence that determines the production of excitability in any substance (an influence that, perhaps, we may still be permitted to call "Life") still remains as great a mystery as ever.

* The writer of this notice is under the impression that the nature of the nerve current is not yet determined.

MODERN GAS PRODUCERS.

At the risk of arousing the wrath of those who will hear patiently nothing but praise of gas producers, whether of suction type or of pressure varieties, we make bold to say that gas production should be, as far as possible, a mechanically conducted operation. It must also be carried out in full view of all the considerations incidental to the use to which the gas is to be put. In some quarters great umbrage seems to have been inspired because the Electrical Review ventured to doubt a figure of cost per unit of work, a figure that all practical power gas men know not to be correct.

Especially is it important to take care not to aim at an

excessive producer efficiency. One of the pioneers of producer gas in this country is Mr. Dowson, and as is well known, he uses steam in his producer in order to secure a greater efficiency. But Mr. Dowson, brought up though he has been with the small gas engine and powerful gas, does not blindly advocate too powerful a gas with modern conditions. He has recently written a book on gas producers, a most excellent work, and in it he cautions his readers against gas too rich in hydrogen on account of its facility of ignition and consequent reduced ability safely, or without risk of pre-ignition, to bear high compression.

Everyone knows that the dissociation of steam requires heat, that the passing of steam into a producer will lower the temperature of the escaping gases, and that the heat thus absorbed will be rendered up when the gas is burned in the engine. But even in this matter it should not be forgotten that when hydrogen is burned to steam gas once more its product has a high specific heat. The specific heat of steam gas is double that of the ordinary exhaust gases from a so-called dry gas, and some of the heat economised is therefore lost in this way.

It is customary to suppose that the temperature of the dry producer must be high, much higher than when steam is employed to absorb some of the surplus heat. But if gas power is to become a big thing in the world, it will not be with coke or anthracite fuel that it will be worked, for there is not enough of these fuels, and, moreover, they are too costly. The fuel of the large gas engine must obviously be coal of the sorts that can be most easily purchased. In this country the coal must be of the bituminous variety, and though the hydrogen in such cases may not be present in large proportion, yet this hydrogen is combined with carbon, and thereby enables carbon to become volatile. In this way a very large percentage of the carbon in bituminous coal may be of the volatile order. These volatile carbons require heat to vaporise them, and though we believe there are no definite experiments to determine the latent heat of vaporising coal, this latent heat is no small quantity, as can very quickly be demonstrated by dropping a little bituminous coal upon a clear red fire. This will be chilled at once, and will remain chilled so long as any bituminous gas is coming off.

In a large gas producer the hot gas from the carbonised coal in the lower regions of the producer passes through the green coal admitted above, and parts with much of its heat in doing so. Then if a producer be worked so entirely on mechanical lines, as it is proposed by Mr. Thwaite it should be, namely, with a small percentage of limestone flux, so that the ash and clinker may be run liquid from a tap hole, there will be some conversion of the carbon dioxide gas, driven off the flux, into carbonic oxide gas at the expense of the temperature of the produced gases. By this reaction we have first $CaO\ CO_2$ + heat = $CaO + CO_2$, and then in the second reaction we have $CO_2 + C$ + heat = $2\ CO$ − heat. The − heat has become latent in gasifying the second atom of C without combustion, and it will be available when the gas is burned. Ordinarily the reduction of the C to gas would give gas worth fully 10,000 B.TH.U. per lb. of its carbon, but this lb. of C, by aid of the waste heat and the CO_2, becomes 2 CO with an available calorific capacity of fully 20,000 B.TH.U. The fluxing process enables producers to be cleaned readily without labour or dust, and the reactions above named afford a means of producing a proper quality of "power" gas with high efficiency, by "power" gas being understood gas of which the combustible portion, is, perhaps, 90 per cent. carbonic oxide. In "heating" gas, it is, of course, desirable to have a better calorific capacity, and to employ steam as the cooling agent, but such gases are apt to contain an excess of CO_2, and, where the highest temperatures are required, a lime purifier might with advantage be employed at least for special small flames or muffles, if not for large furnaces, so as to absorb the CO_2, and increase the intensity of the flame.

It is hardly necessary to point out that gas producers must be made to produce a regular quality of gas. In small producers of but little height, such a demand entails the use of a fuel that will not hang up and form caves and arches and blank corners. The rectangular producer is obviously incorrect, because its square corners are apt to become simple through up-flues through which the air will travel direct to the top of the fuel bed, and will there burn any of the combustible gas which comes through the fuel. But any shallow producer, even of circular form, will burn into hollows unless the fuel be of such a quality as will readily consolidate itself. Hence the almost universal employment of hard anthracite coal which does not clog, lies loo ely and readily falls under the influence of gravity. Bituminous coal demands producers of greater height, so that the weight of the high column will at least consolidate the lower portions and ensure the production of CO and not of CO_2. In a lime-fluxed producer, no doubt, the fluxing of the clinker-forming material will help considerably to prevent hanging-up of the fuel, but height, to give gravity effects, is essential, and if producers be of the square form, they must have rounded corners of large radius so that the above bad effects of square corners shall not take place.

The tendency of the day is towards the fullest utilisation of resources. In coal there are many things which are burned when the coal is used for steam raising, yet are more valuable when saved unburned. Some of these things, such as tar and ammonia, can be saved when gas producers are employed. So far as the process of gas production is concerned, there is no fume of any sort turned into the atmosphere. The most destructive of the products from coal is the sulphur, which ultimately becomes converted into sulphuric acid. It is claimed that if a proportion of lime be mixed with coal, the sulphur will be absorbed by the lime, but against such advantage as this may be, is to be set the awkward fact that lime tends to produce a clinker which would spread upon the bars and choke the air spaces. But if lime, in the form of limestone or chalk, be used as a flux in the producer, it simply enables the clinker to be run out liquid, and no doubt causes an absorption of much of the sulphur of the fuel. Such sulphur as passes away in the gas must, of course, ultimately be present in the engine exhaust, but the proportion will be very much less than that evolved from the fuel consumed to raise steam for an equal steam power. It is, however, suggested that the sulphur gas in the engine exhaust would eventually become sulphuric acid, and that such gas would best be purified and ultimately caused to sulphate the ammonia derived as a by-product of the producer. Could this be done, the final exhaust gases would consist of CO_2 and nitrogen only. However, these are matters for the manufacturing chemist to determine, but it certainly appears feasible commercially to put forth into the atmosphere nothing deleterious, save, of course, the carbon dioxide, and some of this might even be made useful in carbonating sodium salts, as made by the ammonia soda process. And after all, this carbon dioxide is necessary for the growth of plants, which are constantly being buried to form the world's coal many thousands of years hence.

Everything excepting the handiness of the engine calls for gas power rather than steam power, and the gas engine may yet be very much improved. It can scarcely be longer ignored in this country after the manner in which it has acquitted itself on the Continent, and there is no physical or mechanical reason why the gas engine should not be made in sizes as large as the steam engine. That this is not commercially economical we have been told by a great authority on gas engines, but his remarks bore only on the relative costs of construction.

We are not prepared strongly to dissent at the moment, but it is at least rational to suppose that, as with other large engines, the larger sizes will ultimately prove to be cheaper per unit of power than the smaller sizes. The commercial consideration always must be more or less opposed to too rapid an extension of any apparatus in the direction of size and weight.

In the case of engines there are involved new patterns, the provision of larger tools, and of more powerful lifting agencies, and generally such a further and extensive locking up of capital as is not to be too lightly undertaken, especially when those responsible do not always see the future with the same eyes as those not concerned so directly in the provision of the plant. In all probability the future success of the gas engine is bound up with the recognition of carbonic oxide as the power gas of the future, leaving to hydrogen or hydrogenous mixtures the provision of tem-

perature effects for furnaces and metallurgical works. For such high temperature work no pretence is made that blast furnace gas or the dry producer gases are fitted, and it is this very unfitness that does fit them for power purposes, involving high compression, slow burning, non-violent combustion and even turning moment.—W. H. B.

THE ECONOMY OF ELECTRICAL WINDING PLANTS.

Following on Mr. W. C. Mountain's paper on "Electrical Winding," read before the I.E.E. in January, considerable discussion of the subject took place, and at least two opponents of Mr. Mountain's views have published detailed figures showing the economical advantage to lie with electrical winding. Mr. Hooghwinkel in his I.E.E. paper, and Herr V. Graubner in an article in *Elektrotechnik und Maschinenbau*, p. 410, discuss various points in which Mr. Mountain's figures are open to question, and show that a readjustment of these leads to at least a slight advantage in annual cost for electrical over direct steam winding. In discussing these various articles a writer in the *Elektrotechnische Zeitschrift* points out that for a complete settlement of this important question the basis of comparison must be broader than that hitherto chosen, and puts forward the following suggestions :—Considering a steam winding plant of the most modern design, the steam consumption per effective horse-power-hour on the rope may be taken as 44½ lb. over the whole 24 hours' run including all stoppages. This is a lower figure than has hitherto been actually attained, but should be attainable with the latest improvements in the steam-driven machinery.

In the case of the electrical plant equally favourable figures must be adopted, and, again with the latest improvements (including, of course, the Ward-Leonard control and the provision of a heavy fly-wheel for storage on the Ilgner system), the steam consumption in this case may be taken as about 29 lb. per H.P.-hour on the rope. A somewhat higher figure was required in the Zeche Zollern II mine, but this would have been reduced if the heavy fly-wheel had been arranged for disconnection at all times, except when actual winding was in progress.

In estimating the cost of the installation, the cost of boilers and steam pipes must be included, because this cost is, naturally, considerably less in the case of the electrical plant, owing to the lower consumption. Of the central station plant only that part which corresponds to the mean power demand for actual winding should be included in the estimate. Even this is, in fact, an over-estimation in the case of electrical winding—the correct allowance should be that for the difference in cost of plant with and without electric winding. This would be lower than the former figure, because the cost of a station per KW. installed is, naturally, lower as the size of station increases. Further, it is often possible to arrange that pumping and other auxiliary work shall only be done during the intervals of winding, and the introduction of electrical winding would then involve little, if any, increase in plant. In comparisons of steam consumption omission is often made of any allowance for the fact that with the electrical plant the boilers are working at a steady output, whilst with the steam plant the demand is very irregular and must necessarily lead to a fall in boiler efficiency. A difference in coal consumption per lb. of steam of probably quite 10 per cent. occurs on this account in favour of the electrical plant.

The introduction of electric driving has led to an increase in the speed of winding from about 20 ft. to 32 ft. per sec. This means an increased annual output and a reduced working cost, especially in the case of deep mines.

If electrical driving is introduced larger engines can be used, and these work more efficiently than smaller ones. Consequently the power for auxiliary plant, derived from the same generating sets, is obtained with increased economy.

In the case of new mines or extensions to mines, the Ilgner system enables a gradual increase in winding plant to be effected economically, whilst with steam plant an unnecessarily large winding engine, capable of dealing with the maximum probable load, must be installed at the commencement. For instance, the heavy fly-wheel can, at first (whilst the load is low), be entirely omitted, and a low speed of winding can be employed. Later, the fly-wheel can be added and the speed increased, and, finally, a second winding motor can be attached to the drum, and a second motor-generator can be coupled to the fly-wheel, thus doubling the whole plant economically, and without handicapping the undertaking in its earlier years.

Electric driving results in a uniform torque during the whole revolution, and this directly tends to reduce the wear on the rope.

The excellent safety arrangements available with the electrical drive reduce the chance of accidents and, therefore, the working cost.

If these various working economies are carefully considered in each specific case, it seems likely that very few winding plants will fail to show a reduced working cost if converted from steam to electric driving.

UNPUBLISHED PROCEEDINGS OF THE SOCIETY FOR THE EXPRESSION OF PRECISE OPINION.

By "TURRIS."

Internal Combustion Engines.

The opening meeting for the winter session of the Society for the Expression of Precise Opinion was held after a dinner at the Hotel Palatial in the Society's smoking room.

The President, reminding his audience of their motto, "In Vino Veritas," explained that the Council, after an unlimited expenditure of liquid refreshments, had induced one of their honorary members, Mr. Blank Dash, to give his views upon "The Innate Cussedness of Internal Combustion Engines." Mr. Blank Dash was not a manufacturer, hence he felt confident that his remarks would bear a certain rough approximation to the truth. He did not wish to cast undue animadversions upon other institutions, but it certainly seemed as though such bodies as the I.E.E. existed for purposes of mutually reciprocating applause. Mr. Blank Dash was not well known to them. He had never read a paper before the I.E.E. (Applause.) He had never written under a *nom de plume* to an electrical paper. (Sensation.) Therefore his virgin public utterances would be of special interest.

Mr. Blank Dash, in a voice tuned with broken emotion, said that his subject was, not what was the matter with the gas engine, but what wasn't the matter with the gas engine. He had no manufacturing axe to grind. All papers read upon that subject were either written directly by manufacturers or by those in their employ. There were others more qualified to speak on the subject than himself, but the wily manufacturer never allowed them to leave their stations without attendants. His own escape, which he proposed to publish at a later date, was more thrilling than that of Jack Sheppard. But to return to the internal combustion engine, everything was wrong. It was the scandal of Consultation Street. In his own station he had to narrate several defects; for instance, the gas leakage was so bad that the Factory Inspectors had put the station under the Fiery Mines Act. No arc lamps were possible, but miners' safety lamps were always used. Such an atmosphere was dangerous to health, but it enabled them to develop a remunerative by-product trade in copper sulphate. New commutators were fitted by the electrical staff every week, patent agate scrapers and bucket conveyors removing the copper sulphate as formed.

The balancing of the engines was bad. The Otto cycle was incomprehensible, unless one accepted his theory that its action was really a reverse process. It was like a man on a slippery road, who slipped back three paces for each step he made forward. To make any progress he must therefore turn round, and by taking one step nominally forward actually progress two steps towards his desired end. Nobody

had ever told the truth about the Otto cycle, but he had applied Ohm's law, the Zeuner valve diagram, and Mr. Swinburne's views on Efficiency, to his theory, and found that the limit of error was 0·00001 ampere per division, which proved that his theory as to the reverse action of the Otto cycle balanced with the facts within the usual limits of human error. Their worthy president had remarked that he had never read a paper before the I.E.E. He had actually submitted a paper upon this theory, but—

(The speaker was here called to order, being reminded that they were not there to consider theories, but to get at operative truths.)

Mr. Blank Dash then said that in addition to the wear and tear on the sulphate recovery plant, which caused them a great deal of expense, the carbon recovery plant was also a difficulty. Diamond-pointed drills and melinite had to be used to remove the carbon deposit from the combustion chamber. (The trade union wouldn't let them employ Chinese labour for drills.) The reason why the Gasville-on-Sea power station had lost money was due to the cost of diamond drills. (A voice: Why not use an oil giving a soft deposit?) Yes: that had been done, but such soft deposits formed very rapidly, and if the piston rings fitted tightly, the reduced combustion space blew off the cylinder heads. If the piston rings were loose it streamed into the crank chamber, and was best removed by a 3-in. centrifugal pump driven off the exhaust cam shaft.

Ignition was another difficulty. They had used magneto ignition, Ruhmkorff coils giving 10-in. sparks, trembler coils and cadmium standard cells. They had also used a booster. The ultimate solution would lie in coupling a polyphase alternator to the inlet valve levers. The wiring connections were not at all complicated, all that they had to do was to have as many phases as cylinders, and star-connect these at a high-tension step-up transformer with an earth-connected slide.

Breakages were frequent, the cast-iron cams often bursting at the high centrifugal speeds. White-metal bearings contained either too much bismuth, which melted at feed-water temperature, or else too much tungsten, which only melted at the temperature of the electric furnace.

As regarded governing, his engines governed splendidly, running in parallel with a battery, but other people had found that alternators lost several steps, about 10·054 per cent. per minute down hill, or 18·736 per cent. per minute up hill when thrown in parallel, and it was very difficult to make them catch up these lost steps on a frequency of 25 cycles per second.

The discussion was then opened by Mr. Rag Mills, of Aibling's Ridge, who remarked that Mr. Blank Dash's paper marked an epoch in the annals of truth. It was not given to all to emulate George Washington. Yet there were some points upon which he would like to make some remarks. He had never paralleled his two Pibroch engines. No, it was not because black didn't suit his wife's complexion. His first engine rated at 300 H.P. on maker's gas, and an 8,000-ampere per hour battery, had kept a population of 55 customers supplied for two years. Load factor, 0·319 per cent. This was a record. His first engine was peculiar. As cylinder heads sometimes flew off, the makers had made an engine without a cylinder head. The removal of the piston was quite simple. The bolts holding the columns were slacked off, and the cylinders and crank casing lifted bodily up with the shaft by the travelling crane. The whole was deposited upon the floor, the shaft and connecting rods removed, and the assistance of the local dentist invoked in drawing the pistons.

Mr. Smallpaye, of Ousequay, said that his station had been designed for using gas, but that he had gone back to steam on all extensions. They had done the same at Draytonbrick and Blotchingstow. Moreover, he had been informed that the Morning Dawn gas engines used for driving the Timbuctoo overhead electric railway, which had broken down 953 times, were about to be superseded by windmills. (Great sensation.)

Mr. Levfils, of the Sclavonic Hustlinghans Co., of Mud Heap Field and Schnellburgh, humbly craved the permission of the audience to say a few words. He reckoned that the last speaker hadn't got quite the right hog by its tarnation tail. The Timbuctoo overhead wasn't a cinch. He had had experience of several engines, and had conceded the failure of the Morning Dawn engines. When quite away back his name had been associated with the Cock-a-doodle-doo engine. But the new engine which the Sclavonic Hustlinghans Co. were bringing out would lick an already revolutionised creation. It would have 144 cylinders and 12 cranks, the cylinders being placed one above the other with central exhaust valves. The blast from the latter would exhaust through the hollow piston-rods into the closed crank pits, and prevent bearings seizing due to frozen oil. They would be making it in all sizes—from 6 to 600,000 H.P. They calculated to install this pattern free of charge at Timbuctoo, looking to their profit for the returned empty packing cases. That was how they did business at Schnellburgh, Sir. As to the early insinuations concerning the veracity of manufacturers, his own company had been grossly maligned by incompetent rivals, jealous of the perfection of their products, jealous of their business-capabilities, *jealous of—— (At this point the President was awakened from his slumbers, and attempted to closure Mr. Levfils for having spoken from the manufacturer's standpoint, reminding the audience that those connected with manufacturing affairs were only allowed to speak about each other (and never about themselves) on November 31st, February 30th and April 31st. He could not call upon Mr. Blank Dash to reply to the discussion, because that gentleman had been arrested by the police at the instance of the Kohle-Wasser-und-Alleandere-Arte, Gas-Maschinen-Fabrik-Handel, Ausfuhr-Gesellschaft, upon a charge of betrayal of State secrets (Gas-entweichung).

The Backbone of the Berlin A.E.G.—One of the shareholders in the Allgemeine Elektrizitäts Gesellschaft, at the annual meeting held on December 11th in the new administrative buildings on the Friedrich Karl Ufer, Berlin, suggested that the dividend of 11 per cent. for 1905-6 might very well be increased by 1 per cent. by not placing such a large sum to the special reserve fund. Herr Karl Furstenberg, who presided, replied that the reason which had dictated the policy in that respect in former years still prevailed, whilst general director Rathenau made a further explanation, which is of some interest as throwing light on the backbone of the company. He stated that they saw at the turn of the century how business stopped, prices receded, and other large electrical undertakings closed with considerable losses, but the crisis passed over the company's enterprise without in any way causing it to tremble. They owed that for the greatest part to the backbone of the company—the reserves (£1,875,000) and the special reserves (£500,000). They could not abandon that wise policy, because the reserves formed the corner pillars for the construction of their undertaking. Such gloomy times as those mentioned would return—when, they knew not—but they must in any case resist with all their means proposals which could undermine the solid foundation of the company. When the company only had a moderate capital, the shareholders recognised with the directors the need of collecting funds which would be at disposal without any diminution in the annual profits. It was necessary to acquire epoch-making inventions, undertake costly experiments, make displays at exhibitions, &c. The heavy electrical engineering installations, turbines, aluminium production, high-speed railways, the construction of a turbine-equipped steamer, the metallic filament lamps—all those were inventions and equipments which appeared worthy of the sacrifice made. In conclusion, Herr Rathenau declared that the company would continue in that direction in order to maintain its position in the world.

Kriéger Electric Carriages.—It was stated a few months ago, at a meeting of the Société des Voitures Electriques Kriéger, that the company had orders on hand for 356 carriages in 1905-6, and that the year 1906-7 was being entered upon with book orders representing 257 vehicles. In addition to these, the company found it impossible to execute the orders accepted for the production of "Mixte" carriages, and to take over the fresh demands made upon it for other vehicles of a similar kind. These circumstances have led to the decision to erect larger works, and a site has already been acquired for the purpose at Colombes (Seine), where operations will be commenced about the middle of next year. An issue of 4½ per cent. bonds is being made to the extent of £80,000 to meet the expenditure. The manufacturing programme for 1907 comprises 450 carriages, of which 300 will be electrical and 150 will be of the "Mixte" type. In 1908 the company intends to build 600 carriages, of which one-half will be electrical and the remainder of the Mixte class.

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* In case Mr. Levfils should complain that this paraphrase grossly misrepresents this portion of his speech, I must remark that a literal report would burn a hole in the page.—TURRIS.

NEW PATENTS APPLIED FOR.

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28,281. "Improvements in arc lamp electrodes." H. S. Hatfield. December 12th.

28,319. "Process for preparing printing plates by means of electrolytic etching." H. Strecker-Aufermann. December 12th.

28,321. "Improved trolley wire clip." Imeson Bros., Finch & Co. (A. Imeson, A. H. Finch and F. E. Imeson.) December 12th.

28,342. "Electrolytic production of pure tin." A. J. M. Thirot and L. A. Mage (called Nouguier). (Date applied for under Patents Act, 1901, March 26th, 1906, being date of application in France.) December 12th. (Complete).

28,368. "Improvements in prepaid electric meters." W. B. Thorpe. December 12th.

28,369. "Improvements in electric time switches." W. B. Thorpe. December 12th.

28,370. "Improvements in electric furnaces." A. Hiorth. December 12th. (Complete.)

28,395. "Junction appliance for electrical conducting wires applied to material of installations, especially to sockets of incandescent lamps." P. Muller. December 12th.

28,406. "Improvements in plates for secondary and storage cells." E. V. Gratze. December 13th. (Complete.)

28,418. "Improved fusible plug." W. Perry. December 13th.

28,427. "Improvements in electro-magnets or solenoids." C. W. Hill. December 13th.

28,446. "Improvements in the method of and in means for effecting ignition in internal combustion motors." W. A. Trier. December 13th.

28,496. "Improved electrical system for the signalling and controlling of railway vehicles." J. H. K. McCollum. December 13th.

28,503. "Improved method of controlling dynamo-electric machines and apparatus therefor." C. E. Bonine. (Date applied for under Patents Act, 1901, February 17th, 1906, being date of application in the United States.) December 13th. (Complete.)

28,509. "Improvements in protective devices for electrical installations." Allgemeine Elektricitats Ges. (Date applied for under Patents Act, 1901 January 2nd, 1906, being date of application in Germany.) December 13th. (Complete.)

28,522. "Improvements in rests for telephone receivers." R. W. Coan. December 14th.

28,525. "Improved means for adjustable supporting gas burners, electric lamps and the like and the appurtenances thereto." W. Atkinson, J. Smith, E. Smith and H. Atkinson. December 14th.

28,536. "Electric hair brush." F. Burks. December 14th.

28,549. "Submergible electric heater." C. H. Stapledon. December 14th. (Complete.)

28,562. "Automatic starter for continuous current electric motors." Fried Krupp Akt.-Ges. (Date applied for under Patents Act, 1901, March 22nd, 1906, being date of application in Germany.) December 14th. (Complete.)

28,579. "Improved lid bolt for storage battery boxes and the like." The Chloride Electrical Storage Co., Ltd., and B. Heap. December 14th.

28,593. "Improvements relating to the regulation of electric furnaces." C. Bingham. December 14th. (Complete.)

28,600. "Improved process and device in connection with electric arc lamps with supported electrodes." H. Beck and Deutsche Beck-Bogenlampen G.m.b.H. December 14th.

28,601. "Improved process for operating electric arc lamps with supported electrodes." H. Beck and Deutsche Beck-Bogenlampen G.m.b.H. December 14th.

28,602. "Improvements relating to wireless telegraphy." V. Poulsen. (Date applied for under Patents Act, 1901, December 15th, 1905, being date of application in Denmark.) December 14th. (Complete.)

28,617. "Improvements in secondary or storage batteries." S. O. Cowper-Coles. December 15th.

28,628. "Improvement in or connected with electric switches." T. Clark and I. Vlasto. December 15th.

28,637. "Improvements in or relating to electrical fittings, bottle stoppers and the like." A. Waltho. December 15th.

28,688. "New application of induction furnaces." December 15th. G. Gin. (Complete.)

28,669. "Improvements in electric horns for motor vehicles and the like." L. Palous and P. Nathan (trading as Palous & Beuse). (Date applied for under Patents Act, 1901, June 19th, 1906, being date of application in Germany.) December 15th. (Complete.)

28,680. "Improvements in the manufacture of incandescence electric lamps." C. H. Stearn and C. F. Topham. December 15th.

28,682. "Improvements in electrical contact clips or terminals." A. J. Betteridge. December 15th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1904.

Means for Starting and Controlling Alternating Current Motors. W. E. Evans. (Union Elektricitäts Ges.) 13,284. June 11th. (Rights under Patents, &c., Act, 1901, not granted.)

1905.

Printing Telegraphs. L. Kamm. 22,874. November 8th.

Process of Electric Welding especially Applicable to Sheet Metal Articles. L. S. Lachman. 23,077. November 10th. (Date applied for under International Convention, November 17th, 1904.)

Mercurial Vapour Lamps. J. Y. Johnson. (Firm of W. C. Heraeus.) 23,318. November 13th.

Electricity Motor Meters. G. Hookham. 23,561. November 16th.

Electric Transformers and the like. A. P. Zani. 23,720. November 17th.

Electric Telegraphs. Siemens Bros. & Co. and G. S. Grimston. 23,997. November 21st.

Electric Arc Lamps. H. Bevis and A. E. Angold. 24,061. November 22nd.

Apparatus for Changing the Frequency of Alternating Electric Currents. British Thomson-Houston Co. (General Electric Co.) 23,838. November 18th.

Dynamo-Electric Machines Provided with Commutators. British Thomson-Houston Co. (General Electric Co.) 23,839. November 18th.

Elastic Suspension Devices for the Electric Motors of Tramcar and like Trucks. M. B. Mountain, G. M. Gibson and A. F. H. Head. 24,058. November 22nd.

Dynamo-Electric Machinery. C. A. Parsons and A. H. Law. 24,141. November 22nd.

Electric Switches. British Thomson-Houston Co. (General Electric Co.) 24,236. November 23rd.

Junction Boxes and Similar Apparatus for the Connection of Electric Cables or the like. A. T. Dawson and A. P. Pyne. 24,389. November 24th.

Apparatus for Controlling Electric Circuits. British Westinghouse Electric & Manufacturing Co. (Westinghouse & Manufacturing Co.) 24,403. November 27th.

Regulation of Alternating Current Electric Motors. Elektricitäts Akt.-Ges. vorm. W. Lahmeyer & Co. 25,147. December 4th. (Date applied for under International Convention, December 2nd, 1904.)

Electric Motor Control Systems. British Thomson-Houston Co. (General Electric Co.) 25,513. December 7th.

Monetary Recorder for Use in Combination with the Ordinary Telephone Instrument. J. H. Langley and E. W. Mason. 25,533. December 8th.

1906.

Mercury Vapour Electric Lamps. G. T. Fairbrother. 4,565. February 24th.

Means for Protecting High-Tension Overhead Electric Conductors. L. Neu. 9,026. April 14th.

Electrical Devices for Simultaneously Actuating the Controllers of Several Railway Vehicles from any one of these Vehicles. Compagnie de L'Industrie Electrique et Mecanique. 9,630. April 24th. (Date applied for under International Convention, April 25th, 1905.)

Elbows for Conduits for Electric Wires. C. C. Sibley and G. A. Lutz. 10,655. May 7th.

Electric Signalling Apparatus. H. Becker. 11,303. May 14th.

Electrically Propelled Vehicles. H. H. Lake. (Scc. Anon. Electromotion.) 11,668. May 18th.

Electric Furnaces. H. Röchling and W. Rodenhauser. 12,329. May 26th.

Contact Making and Circuit Controlling Devices Employed in Connection with the Signalling and Point Shifting Arrangements and the Time Recording Devices of Electric Tramways and the like. Brecknell, Munro & Rogers, Ltd., and E. M. May. 12,694. May 31st.

Electrical Device for Recording the Breaking of a Fire Prevention Sprinkler. W. G. Meddings. 13,117. June 6th. (Date applied for under International Convention, January 18th, 1906.)

Electric Heat Alarm Apparatus. J. Moores. 13,739. June 14th.

Pulleys for the Trolleys of Electric Railways, Tramways and other Purposes. H. Welsh. 16,837. July 26th.

Method of Making Dynamo Brushes. G. Preuss. 17,115. July 30th. (Date applied for under International Convention, July 28th, 1905.)

Electric Light Fitting. H. Faraday. 626. January 9th.

Electric Arc Lamps. British Thomson-Houston Co. and E. J. Murphy. 1,807 January 17th.

Brush-Holders for Dynamo-Electric Machines. J. T. Westwood and W. J Jones. 1,541. January 20th.

Electric Switches for Electric Traction on the Surface Contact System. R. Brown. 1,818. January 24th.

Electric Tramcars. J. A. Lycett and G. J. Conaty. 3,096. February 8th.

Electric Arc Lamps. British Thomson-Houston Co. (General Electric Co.) 3,457. February 12th.

Process of Electrically Connecting the Filaments of Electric Glow Lamps with Thin Supply Wires. H. Kuzel. 12,153. May 24th. (Date applied for under International Convention, August 4th, 1905.)

Electrical Apparatus for Calibrating Measuring Instruments for Alternating Currents. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 14,684. June 27th.

Electric Fire Alarms and like Systems. H. Garstang. 15,662. July 11th.

Systems of Wireless Telegraphy Applicable to Railway Trains and the like. W. P. Thompson. (Gesellschaft für Drahtlose Telegraphie.) 16,606. July 24th.

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28,281. "Improvements in arc lamp electrodes." H. S. Hatfield. December 12th.

28,319. "Process for preparing printing plates by means of electrolytic etching." H. Strecker-Auffermann. December 12th.

28,321. "Improved trolley wire clip." Imeson Bros., Finch & Co. (A. Imeson, A. H. Finch and F. E. Imeson.) December 12th.

28,342. "Electrolytic production of pure tin." A. J. M. Thirot and L. A. Mage (called Nouguier). (Date applied for under Patents Act, 1901, March 26th, 1906, being date of application in France.) December 12th. (Complete).

28,368. "Improvements in prepaid electric meters." W. B. Thorpe. December 12th.

28,369. "Improvements in electric time switches." W. B. Thorpe. December 12th.

28,370. "Improvements in electric furnaces." A. Hiorth. December 12th. (Complete.)

28,395. "Junction appliance for electrical conducting wires applied to material of installations, especially to sockets of incandescent lamps." P. Muller. December 12th.

28,406. "Improvements in plates for secondary and storage cells." E. V. Gratze. December 13th. (Complete.)

28,418. "Improved fusible plug." W. Perry. December 13th.

28,427. "Improvements in electro-magnets or solenoids." C. W. Hill. December 13th.

28,446. "Improvements in the method of and in means for effecting ignition in internal combustion motors." W. A. Trier. December 13th.

28,496. "Improved electrical system for the signalling and controlling of railway vehicles." J. H. K. McCollum. December 13th.

28,503. "Improved method of controlling dynamo-electric machines and apparatus therefor." C. E. Bonine. (Date applied for under Patents Act, 1901, February 17th, 1906, being date of application in the United States.) December 13th. (Complete.)

28,509. "Improvements in protective devices for electrical installations." Allgemeine Elektricitats Ges. (Date applied for under Patents Act, 1901 January 2nd, 1906, being date of application in Germany.) December 13th. (Complete.)

28,522. "Improvements in rests for telephone receivers." R. W. Coan. December 14th.

28,525. "Improved means for adjustable supporting gas burners, electric lamps and the like and the appurtenances thereto." W. Atkinson, J. Smith, E. Smith and H. Atkinson. December 14th.

28,536. "Electric hair brush." F. Burke. December 14th.

28,549. "Submergible electric heater." C. H. Stapledon. December 14th. (Complete.)

28,562. "Automatic starter for continuous current electric motors." Fried Krupp Akt.-Ges. (Date applied for under Patents Act, 1901, March 22nd, 1906, being date of application in Germany.) December 14th. (Complete.)

28,579. "Improved lid bolt for storage battery boxes and the like." The Chloride Electrical Storage Co., Ltd., and B. Heap. December 14th.

28,593. "Improvements relating to the regulation of electric furnaces." C. Bingham. December 14th. (Complete.)

28,600. "Improved process and device in connection with electric arc lamps with supported electrodes." H. Beck and Deutsche Beck-Bogenlampen G.m.b.H. December 14th.

28,601. "Improved process for operating electric arc lamps with supported electrodes." H. Beck and Deutsche Beck-Bogenlampen G.m.b.H December 14th.

28,602. "Improvements relating to wireless telegraphy." V. Poulsen. (Date applied for under Patents Act, 1901, December 15th, 1905, being date of application in Denmark.) December 14th. (Complete.)

28,617. "Improvements in secondary or storage batteries." S. O. Cowper-Coles. December 15th.

28,628. "Improvement in or connected with electric switches." T. Clark and I. Vlasto. December 15th.

28,637. "Improvements in or relating to electrical fittings, bottle stoppers and the like." A. Waltho. December 15th.

28,638. "New application of induction furnaces." December 15th. G. Gin. (Complete.)

28,669. "Improvements in electric horns for motor vehicles and the like." L. Palous and P. Nathan (trading as Palous & Beuse). (Date applied for under Patents Act, 1901, June 19th, 1906, being date of application in Germany.) December 15th. (Complete.)

28,680. "Improvements in the manufacture of incandescence electric lamps." C. H. Stearn and C. F. Topham. December 15th.

28,682. "Improvements in electrical contact clips or terminals." A. J. Betteridge. December 15th.

PUBLISHED SPECIFICATIONS.

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1904.

Means for Starting and Controlling Alternating Current Motors. W. E. Evans. (Union Elektricitäts Ges.) 13,284. June 11th. (Rights under Patents, &c., Act, 1901, not granted.)

1905.

Printing Telegraphs. L. Kamm. 22,874. November 8th.

Process of Electric Welding especially Applicable to Sheet Metal Articles. L. S. Lachman. 23,077. November 10th. (Date applied for under International Convention, November 17th, 1904.)

Mercurial Vapour Lamps. J. Y. Johnson. (Firm of W. C. Heraeus.) 23,318. November 13th.

Electricity Motor Meters. G. Hookham. 23,561. November 16th.

Electric Transformers and the like. A. P. Zani. 23,720. November 17th.

Electric Telegraphs. Siemens Bros. & Co. and G. S. Grimston. 23,997. November 21st.

Electric Arc Lamps. H. Bevis and A. E. Angold. 24,061. November 22nd.

Apparatus for Changing the Frequency of Alternating Electric Currents. British Thomson-Houston Co. (General Electric Co.) 23,838. November 18th.

Dynamo-Electric Machines Provided with Commutators. British Thomson-Houston Co. (General Electric Co.) 23,839. November 18th.

Elastic Suspension Devices for the Electric Motors of Tramcar and like Trucks. M. B. Mountain, G. M. Gibson and A. F. H. Head. 24,058. November 22nd.

Dynamo-Electric Machinery. C. A. Parsons and A. H. Law. 24,141. November 22nd.

Electric Switches. British Thomson-Houston Co. (General Electric Co.) 24,236. November 23rd.

Junction Boxes and Similar Apparatus for the Connection of Electric Cables or the like. A. T. Dawson and A. P. Pyne. 24,339. November 24th.

Apparatus for Controlling Electric Circuits. British Westinghouse Electric & Manufacturing Co. (Westinghouse & Manufacturing Co.) 24,403. November 27th.

Regulation of Alternating Current Electric Motors. Elektricitäts Akt.-Ges. vorm. W. Lahmeyer & Co. 25,147. December 4th. (Date applied for under International Convention, December 2nd, 1904.)

Electric Motor Control Systems. British Thomson-Houston Co. (General Electric Co.) 25,513. December 7th.

Monetary Recorder for Use in Combination with the Ordinary Telephone Instrument. J. H. Langley and E. W. Mason. 25,533. December 8th.

1906.

Mercury Vapour Electric Lamps. G. T. Fairbrother. 4,565. February 24th.

Means for Protecting High-Tension Overhead Electric Conductors. L. Neu. 9,026. April 14th.

Electrical Devices for Simultaneously Actuating the Controllers of Several Railway Vehicles from any one of these Vehicles. Compagnie de L'Industrie Electrique et Mecanique. 9,630. April 24th. (Date applied for under International Convention, April 25th, 1905.)

Elbows for Conduits for Electric Wires. C. C. Sibley and G. A. Lutz. 10,655. May 7th.

Electric Signalling Apparatus. H. Becker. 11,303. May 14th.

Electrically Propelled Vehicles. H. H. Lake. (Scc. Anon. Electromotion.) 11,668. May 18th.

Electric Furnaces. H. Röchling and W. Rodenhauser. 12,329. May 26th.

Contact Making and Circuit Controlling Devices Employed in Connection with the Signalling and Point Shifting Arrangements and the Time Recording Devices of Electric Tramways and the like. Brecknell, Munro & Rogers, Ltd., and E. M. May. 12,694. May 31st.

Electrical Device for Recording the Breaking of a Fire Prevention Sprinkler. W. G. Meddings. 13,117. June 6th. (Date applied for under International Convention, January 18th, 1906.)

Electric Heat Alarm Apparatus. J. Moores. 13,739. June 14th.

Pulleys for the Trolleys of Electric Railways, Tramways and other Purposes. H. Welsh. 16,837. July 26th.

Method of Making Dynamo Brushes. G. Preuss. 17,115. July 30th. (Date applied for under International Convention, July 28th, 1905.)

Electric Light Fitting. H. Faraday. 626. January 9th.

Electric Arc Lamps. British Thomson-Houston Co. and E. J. Murphy. 1,307. January 17th.

Brush-Holders for Dynamo-Electric Machines. J. T. Westwood and W. J Jones. 1,541. January 20th.

Electric Switches for Electric Traction on the Surface Contact System. R. Brown. 1,818. January 24th.

Electric Tramcars. J. A. Lycett and G. J. Conaty. 3,096. February 8th.

Electric Arc Lamps. British Thomson-Houston Co. (General Electric Co.) 3,457. February 12th.

Process of Electrically Connecting the Filaments of Electric Glow Lamps with Thin Supply Wires. H. Kuzel. 12,153. May 24th. (Date applied for under International Convention, August 4th, 1905.)

Electrical Apparatus for Calibrating Measuring Instruments for Alternating Currents. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 14,684. June 27th.

Electric Fire Alarms and like Systems. H. Garstang. 15,682. July 11th.

Systems of Wireless Telegraphy Applicable to Railway Trains and the like. W. P. Thompson. (Gesellschaft für Drahtlose Telegraphie.) 16,696. July 24th.

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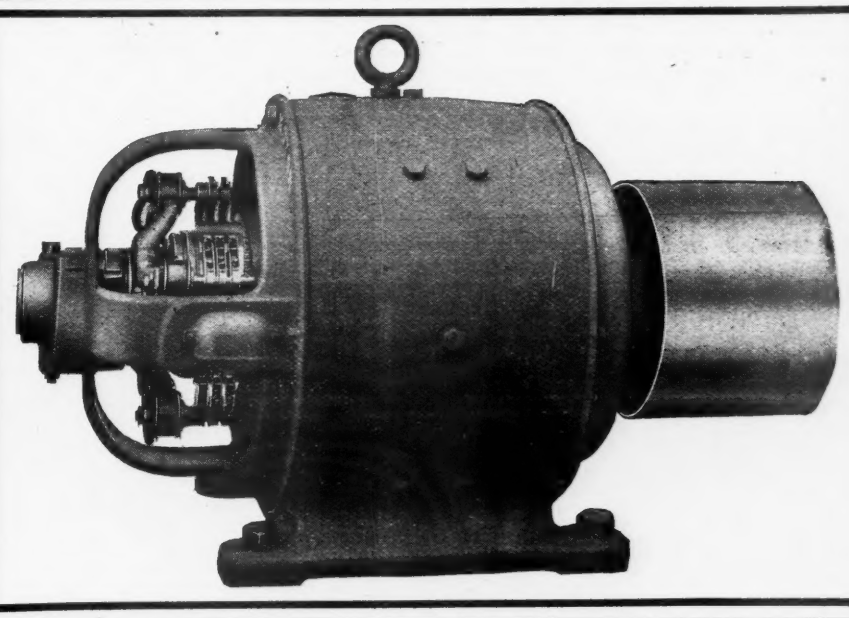

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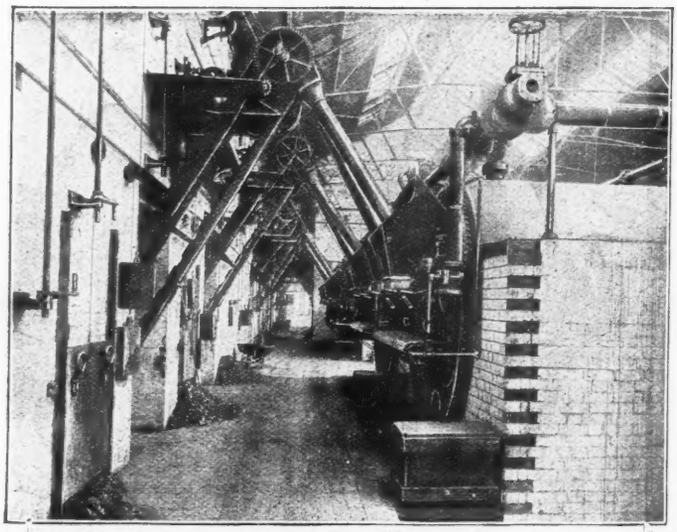

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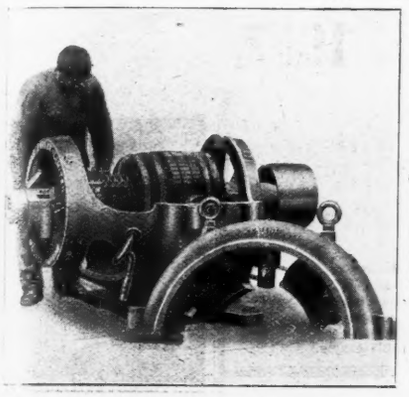

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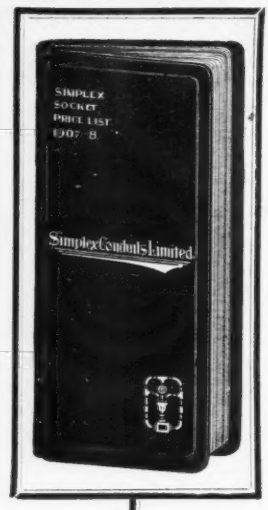

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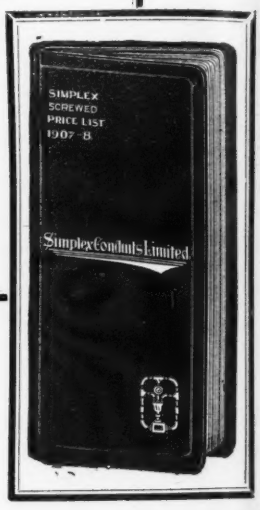

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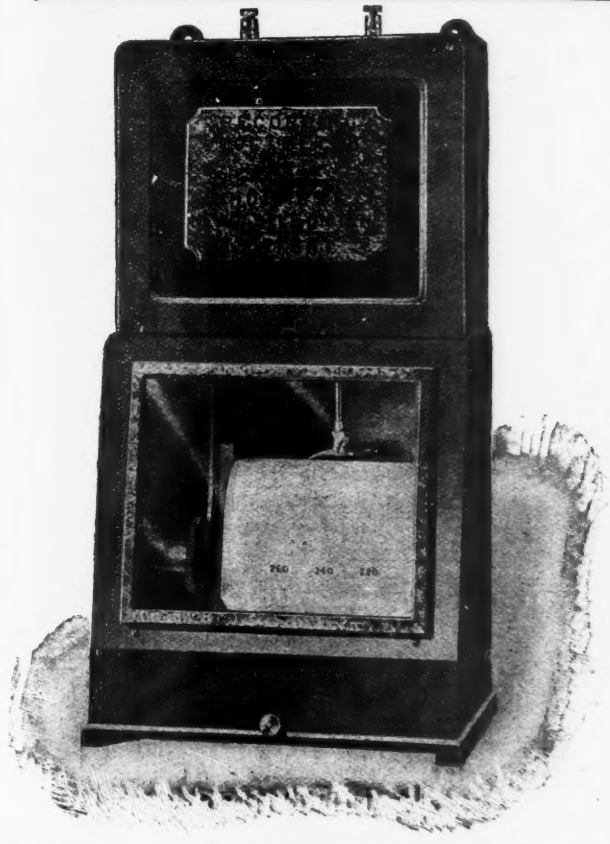

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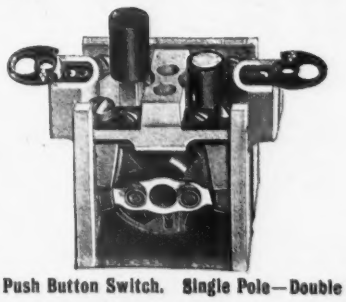

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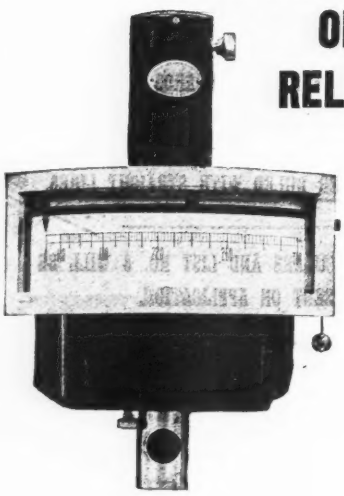

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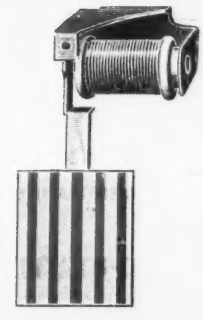

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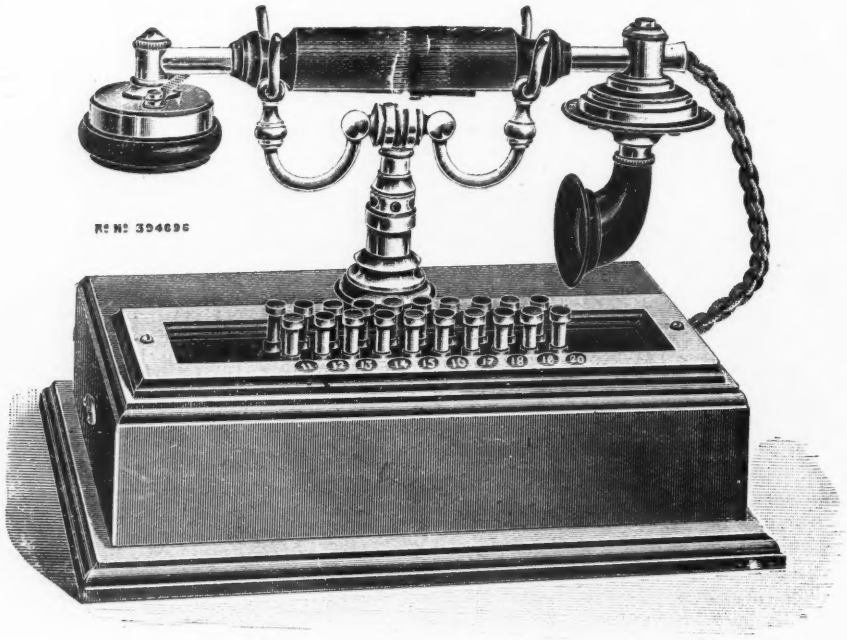

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WOLFINGTON ROAD, WEST NORWOOD, S.E.

Messrs. PERCY HUDDLESTON & CO.

Have been instructed by CARL HENTSCHEL, 1906, LTD., who are now taking their Electric Supply from the Mains,

To Sell by Public Auction,

On Tuesday, January 8th, 1907,

At 2.30 precisely,

The Complete Electrical Installation,

Comprising ONE 80-H.P. OTTO GAS ENGINE, ONE 24-H.P. DITTO, by Crossley Bros., Ltd.; ONE 51-H.P. STOCKPORT GAS ENGINE, ONE 45-H.P. DITTO, by J. E. H. Andrew & Co., Ltd.; FIVE COMPOUND WOUND DYNAMOS: One 200 volts 110 amperes; One 110 volts 150 amperes, by Crompton & Co., Ltd.; One 112 volts 250 amperes, by Siemens Bros. & Co., Ltd.; One 112 volts 120 amperes; One 65 volts 350 amperes, by Westinghouse Co., Ltd., and One Shunt Ditto, 65 volts 200 amperes. Two Spare Armatures; Switchboards; Twenty Arc Lamps; Cable and Wire; Six Belts; Floor Plates; Four Circular Tanks; Wrought Iron Tank, 13' 6" × 8' × 3'; Ditto, 10' × 3' × 3'; Ditto, 9' 6" × 8' 6" × 5'; Valves, Piping and Numerous other Effects.

On view Day previous and Morning of Sale. Catalogues can be had of PERCY HUDDLESTON & Co., Electrical and Mechanical Auctioneers and Valuers, 72, Finsbury Pavement, London, E.C., and 16, Albany Road, Bedford. Telegrams: "Sultanship, London"; Telephone: "585 London Wall," "620 Chiswick." 1154

SITUATIONS VACANT.

Latest time for receiving, 9.30 a.m. Thursday.

If letters are not to be delivered to certain firms or individuals (if known), instructions to that effect should be sent to the Manager of the ELECTRICAL REVIEW, who will do his best to carry out such instructions. Letters of applicants cannot in such cases be returned to them, nor can the names of Advertisers using a number in any way be disclosed.

Original Testimonials should never be sent.

DEVON COUNTY ASYLUM.

WANTED a second Resident Engineer. He must be a thoroughly well-trained mechanic accustomed to take charge of electric and steam power appliances, telephones, electric lighting, &c.

He must also be a good engineering fitter.

Wages thirty shillings (30s.) per week, with cottage free.

Applicants to state age, also whether married or single.

Testimonials and applications to be delivered to me not later than the 29th instant.

E. H. HARBOTTLE, F.R.I.B.A.,
Architect of the Devon County Asylum.

County Chambers,
Exeter, *December 13th*, 1906. 1092

SITUATIONS VACANT.—*Continued.*

ARGENTINE REPUBLIC.

WANTED, for 25th January, first-class Fitter and Erector to erect water-tube boiler, high-speed engine and dynamo and condensing plant in Argentine Republic. Experience with high-speed engines essential. Previous experience abroad and knowledge of Spanish desirable. Engagement for six months. Salary £25 per calendar month. Free second-class passage out and home. Full pay during voyage.

Application by letter only to Messrs. PREECE & CARDEW, 8, Queen Anne's Gate, Westminster, S.W., to be sent in not later than JANUARY 3rd, giving age and brief particulars of experience, with names of two personal references. 1157

Owing to the many hundreds of replies passing through this Office each week, we would ask those answering Advertisements to be extremely accurate in giving the correct figures when addressing replies to Box Numbers.

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A—APPOINTMENTS at Big Salaries constantly secured in the Submarine and Wireless Telegraph Services by Students of the London Telegraph Training College. Two at £150 p.a. obtained last month. The College is licensed for Wireless Telegraph Instruction by the Postmaster-General, and in view of what has taken place at the Berlin Conference, it is important to note that it is the only Institution in the United Kingdom in which instruction in all Systems of Wireless Telegraphy is given, and in which the actual messages transmitted by the different companies to distant stations and to ships at sea can be received and read by advanced students. Marconi's Wireless Telegraph Co. (Ltd.) have agreed to consider all nominations for Appointments made by the College.—Apply for Prospectus to the SECRETARY ("C."), Morse House, Earl's Court, S.W. 1009

APPOINTMENTS.—Young Men trained for excellent positions in the Submarine Cable and Wireless Telegraph Services at the British School of Telegraphy, 179, Clapham Road, London, S.W. Principal, Mr. William Lynd, the well-known Science Lecturer and Telegraph Expert. Licensed by H.M. Postmaster-General for Wireless Telegraph Instruction. Important Notice.—The Principal has the authority to use for the training of Wireless Telegraph Operators, Marconi Installations Supplied by Marconi's Wireless Telegraph Co., Ltd.—Write at once to SECRETARY for full particulars. (See article in ELECTRICAL REVIEW, June 15th, 1906.) 1097

BOROUGH Electrical Engineer has a vacancy for Pupil, to commence duties in the New Year.—For terms, &c., apply L. H. KING, Council Offices, Whitby. 1028

COST and Estimating Clerk required with experience in electrical trade.—Apply stating age, experience, and salary required to TELEPHONE WORKS, Beeston, Notts. 1153

EXPERIENCED man wanted by large electric power and light distribution company to call on prospective consumers. Must be energetic, of good appearance and ability. Wages £2 per week, and season ticket. Give full particulars as to age, experience and references.—1169, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

(Continued on next page.)

H

SITUATIONS VACANT.—*Continued.*

FOREMEN, with thorough experience in general cable laying, wanted. State wages required.—1166, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

JOINTERS, first-class, wanted. State experience and wages required.—1165, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

JUNIOR Draughtsman required in Electrical Instrument Works. Must have had shop experience and be competent to design small details.—1150, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

LARGE Electrical and Mechanical Firm in the Midlands require two Rate-Fixers; must be practical men; none but first-class mechanics need apply. Good salary to competent men.—1016, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

LEADING hand for arc lamp assembling. Good opportunity for thoroughly capable and energetic young man.—State experience and requirements to 405, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

PREMIUM Pupil.—Vacancy for Pupil to obtain experience in all branches of central station work.—Apply Electricity Works, Canterbury. 1091

PREMIUM Pupil.—Vacancy occurs in municipal works in provinces to learn all branches of central station and installation work. Small salary.—1174, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SWITCHBOARD Attendant wanted, must have had previous experience on three-wire low-tension system. Commencing wage 17s. 6d. per week. Apply, giving full particulars of previous experience, together with references (copies), stating when at liberty.—NORTHAMPTON ELECTRIC & POWER CO., Northampton. 1173

VACANCY for Pupil (premium) in Ipswich Corporation Electric Lighting and Tramways Departments. Opportunity to gain good all-round experience in power station (2400 H.P.), tramway shops, mains, traffic and installation departments.—1123, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED immediately, Draughtsman, used to intricate small electrical apparatus.—State age, salary, and references to 1143, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, an Electrician to superintend an accumulator charging plant. Must be thoroughly experienced in repairs.—Apply by letter giving full particulars of previous situation and the nature of the work performed, also state age and salary earned to GRID, c/o Dixon's, 195, Oxford Street, W. 1142

WANTED, experienced Glassblower for chemical and physical apparatus; preference given to one having experience in working quartz with an oxy-hydrogen blow-pipe.—Apply by letter, stating age, experience and wages required, to 1159, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED Electrician accustomed to colliery work for night duty.—Apply M. W. WATERHOUSE, Exhall Colliery, Bedworth, Nr. Nuneaton. 1149

WANTED, Switchboard Attendants for large industrial firm near Manchester. Resident in Pendlebury district preferred. Eight-hour shifts. Only steady men need apply.—State age, experience, &c.—1006, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, a first-rate man to work and manage a Cable Factory abroad. Applicants must have a thorough knowledge of every detail of the business, and be able to instruct workmen. A good salary will be paid.—Apply by letter, giving full particulars to 1074, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SITUATIONS VACANT.—*Continued.*

WANTED, an experienced Leading Draughtsman, on direct-current generator work. One experienced in turbo-generator work preferred.—Address, giving age, experience in full, and salary required, to "S. C. T.," at Horncastle's, 61, Cheapside, E.C. 1096

WANTED, Electrical Technical Graduate, with some practical experience, for evening work at home, must reside London district.—Address 1090, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WIREMAN, young, wanted for Midlands, used to telephones and lighting; wages 25s.—State experience and reference to 1152, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

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APPOINTMENTS FILLED.

SHORTHAND and Typewriting Clerk, Box 1031, Dec. 14, 1906.—Applicants are thanked and notified that the position is now filled. 1160

SITUATIONS WANTED.

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ADVERTISER (age 32) desires situation as Working Foreman, 17 years' practical experience. Lighting, power, telephones, also the maintenance of plants. Estimating and buying, would take charge of lighting and power installations.—Address, "S.," 21, Prince Street, Long Eaton. 1051

ADVERTISER (23) requires situation as Storekeeper, Despatch Clerk or any capacity, excellent references.—BROWN, 129, Coventry Street, Bethnal Green. 1115

ADVERTISER (age 33), with long practical experience with principal London electrical contracting and maintenance firms, also estimating and buying, desires permanent position as Foreman, Engineer or Manager.—1163, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AS Manager of Contracting Business, preferably South Coast; long practical experience power and lighting, direct and polyphase current, telephones, colliery and dock plants, &c.—1052, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ASSISTANT Wireman wants job (age 22).—"C. S.," 14, King's Mews, Theobalds Road, W.C. 1167

ELECTRICIAN (24), life experience, present position two years, gas, steam, oil engines, dynamos, and accumulators; good wireman; references; abstainer.—"ENGINEER," 264, High Street, Stratford. 1053

(Continued on next page.)

County Chambers,
Exeter, *December 13th*, 1906. 1092

(Continued on next page.)

H

SITUATIONS WANTED.—*Continued.*

ELECTRICAL Trades Union. Telegrams: "Eltradion, London"; Telephone: 623 Central.—Employers requiring Competent Workmen can obtain same at short notice by use of telephone or post to A. EWER, Club Union Buildings, Clerkenwell Road, E.C. 359

ELECTRICIAN desires engagement, experienced in charge of heavy power plants, good references.—1117, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN, young (small wages for plant), or wiring.—28, Auckland Road, Battersea. 1073

ELECTRICIAN (22) seeks re-engagement; six years' references, technical training, would go abroad.—1062, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

JOINTER-Wireman wants job; used to connecting up consumers throughout; arcs, &c.; good references.—"C.," 47, Upton Road, Southgate Road. 1171

WIREMAN wants work, any distance, good references.—MOUNCEY, 31, Cunliffe Street, Streatham. 1076

WIREMAN, all-round mechanic, wants job.—"ELECTRIC," 30, St. James Road, Bermondsey. 1170

WIREMAN, quick, competent, Simplex casing, barrel, capable charge hand. Good refs.—GALT, 103, Lofting Road, Islington. 1161

WIREMAN'S Assistant, general experience, good references.—CHEVERTON, 56, Gabriel Street, Forest Hill. 1048

WORKS Foreman seeks situation; complete knowledge of switchboard, instruments and similar work. Had sole charge of 150 to 200 hands. Excellent references.—GARDNER, 59, Landsdown Road, Walthamstow, Essex. 1156

YOUNG Engineer seeks position, tramway or lighting station. Three years on three-wire D.C. plant, shop experience, examination certificates, electricity and chemistry. Small salary.—Apply LITCHFIELD, Broughton, Eccleshall, Staffs. 1168

PARTNERSHIPS.

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A PARTNER required, with about £600, in well-established Telegraph Training College. Knowledge of telegraphy not essential, but some electrical and commercial experience desirable. Full information to principals at private interview only. Genuine opportunity. Highest references given and required.—Write in first instance to "M. M. C.," at Hornoastle's, 61, Cheapside, E.C. 1148

GENTLEMAN, with capital and works experience, desires active interest in sound established business in North of England or Scotland.—1164, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Partner, with capital, for the manufacturing of an Electrical Apparatus (patent) having already a good sale.—1038, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENCIES.

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A WEALTHY Company of long standing with wide connections and a rapidly increasing business, is prepared to offer a valuable agency to capable business man of good appearance and address. London or provincial towns.—Address, 1070, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

CABLES.—Traveller, with good connection, is open to represent cable manufacturers.—Address Box 114, Wheeler's Advertising Office, Manchester. 983

THE Armorduct Manufacturing Co., Ltd., are open to appoint energetic Agents in Bristol, Birmingham, Nottingham, Belfast, and Dublin. Only responsible firms who have storage accommodation and live connection for conduit and cable with the best buyers need apply.—Apply, stating references, to Head Office, Farringdon Avenue, E.C. 1144

BUSINESSES FOR SALE AND WANTED.

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BUSINESS for Sale.—Small Electrician's Business for immediate disposal, large manufacturing centre, easy ingoing.—Apply in first instance, 1071, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Contractors, with Motor and Cycle Engineering Business for sale, in good southern provincial town, well established, and a genuine bargain.—Apply to 1004, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WELL-Established Electrical Engineers and Contractors business in the Midlands, with first-class connection, exceptional opportunity for capable man, price £300, only reason for selling owner going abroad.—1172, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR SALE.

GREAT NORTH OF SCOTLAND RAILWAY COMPANY.

SALE of Second-hand Engines, Dynamos, &c., for Electric Lighting.
Schedules to be obtained of the Stores Superintendent, 80, Guild Street, Aberdeen.

T. S. MACKINTOSH,
Secretary.

Aberdeen, *December 22nd*, 1906. 1155

(Continued on next page.)

FOR SALE.—*Continued.*

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CASH Offers wanted immediately for the following:—150 100-v. 25 and 32-c.p. Lamps, 6 gross Wall Plugs, 20 gross Switches, large quantity Main Switches and fuseboards, 6 gross 100-v. ceiling roses, also large assortment Electric Fittings. Small quantity supplied; any reasonable offer accepted.—JENNINGS, Builder, Argyle Road, Ealing. 1141

DECLINING Business.—For Sale, at low price, Two Steam Tractors practically new, central steering, will draw 6 to 8 tons up inclines. Can be seen working by appointment.—Address 1035, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FLAME Arc Lamps.—16 Second-hand Flame Lamps for Sale; direct current; good condition.—Apply BAUGHAN & Co., Reading. 1012

FLAME Arc Lamps.—Four Flame Arcs For Sale, direct current. What offers?—Apply, 132A, Western Road, Brighton. 1114

FOR Sale.—Electric Generating Plant, consisting of three 60 B.H.P. Hori. Compound Engines (by Ruston, Proctor and Co.) 10″ and 16″ cyls., 18″ stroke, 100 revs.; three two-pole compound-wound Dynamos (by Crompton & Co.), 105 volts, 370 amps., 750 revs.; one Booster (by Crompton & Co.), Motor, 105 volts, 5½ B H.P., Generator 85 volts 100 amps.; slate Switchboard, 8′ 6″ × 5′ 8″. Can be seen near Newcastle-on-Tyne.—For further particulars and permission to view, apply THOS. W. WARD, LIMITED, Albion Works, Sheffield. 7243

FOR Sale or Hire, high-class Dynamos, Motors, Alternators, Cable and Arc Lamps.—PERCY HUDDLESTON & Co., 72, Finsbury Pavement, E.C. 711

FOR Sale.—One 5-B.H.P. 400 v., D.C. compound, E.C.C. totally enclosed motor, 900 revs. One 18″ 200 v. "Blackman" porthole fan, both in excellent condition.—MISKIN & RICE, 110, St. Martin's Lane, W.C. 1034

FOR Sale, 53 KW Willans & Robinson compound Engine, direct coupled to a D.C. Elwell Parker Dynamo, 440 to 500 volts, in first-class condition, ready for immediate delivery. Cheap.—WILLIAMS, South Bermondsey Station, London, S.E. 1082

FOR Sale, 100 KW. Allen's Two-Crank Engine, direct-coupled to a D.C. Dynamo, 440/500 volts, 350 r.m.p. (nearly new).—WILLIAMS & SONS, South Bermondsey Station, London, S.E. 1083

FOR Sale, 160-KW. three-crank compound enclosed Engine direct coupled to a multipolar C.C. Dynamo, 500 volts, only done a few weeks' work. Can now be seen working. Cheap to save second removal.—WILLIAMS AND SONS, South Bermondsey Station, London, S.E. 1084

FOR Sale, cheap, a quantity of Arc Lamps, various makes, open and enclosed.—COMMERCIAL ELECTRIC Co., 2, Victoria Street, Manchester. 1158

GLASS Shades for Electric Lighting in every variety of design and colour. JOHN WALSH WALSH, Glass Manufacturer, Birmingham. 1042

FOR SALE.—*(Continued).*

LANGDON-Davies Motors, 1 B.H.P. 200 volts 100, ~, complete with starter, perfect condition, £7 10s.—LEWIS, Duke Street, Chelmsford. 1162

ONE Secondhand Motor by Parkers, Ltd., Wolverhampton, 105 Volts, 80 amperes at 850 revolutions; also Rheostat and quantity of main cable for same. In perfect working order. Reason for selling due to alteration in driving of shafting.—ADAMS BROS., Raunds. 1151

ONE 9-volt 700-amp. Depositing Plant, running at 200 volts, new; one 150-volt 45-amp. 1100 revs. Taunton Dynamo with two bearings; good as new and guaranteed; £21.—Apply, BAXTER & CAUNTER, 86, Charing Cross Road, London. 8200

THREE Brush Series Arc Lighting Plants complete, consisting of the following: Each set has 10 ampere Series Arc Lighting Dynamo of Brush Electrical Co.'s Manufacture, and of ample capacity to light 25 arc lamps, coupled direct to a Robey's Horizontal Enclosed Engine by Laminated Belt; the Engine is totally enclosed, crank running in oil bath, speed about 250 r.p.m., and it is complete with Sight Feed Lubricator and Solenoid Brake; have been running on 50 lbs. steam pressure, each set complete with 25 Brush Arc Lamps for each Generator, complete with Ammeters, Fuses, &c., and an ample supply of Carbons for same. These Plants have been running up to a very recent date with every success, and taken out owing to a more modern plant being installed. A Bargain, will sell cheap to clear. Suitable for collieries, quarries, docks, or harbours.—1122, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

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500 CIRCUIT-Breakers, overload type, in London stock, made by Western Electric Company, Chicago; new, low prices, immediate delivery.—I.T.E. ELECTRIC Co., LTD., 20, Great Russell Street, London, W.C. Sole representatives for the I.T.E. Circuit Breaker. 424

ARTICLES WANTED.

WANTED TO PURCHASE FROM ELECTRIC LIGHTING Companies and Electrical Engineers, old and obsolete Dynamos, Motors, Cable, Wire, Instruments, and every description of Electrical Material, also Manufacturers' Surplus Stocks. The bulk being for re-use, high cash prices can be paid.—A. VEBEY AND Co., Dover. Principal in London three days a week. Telegraphic Address: "Verey, Dover." 8514

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A.—TO Electric Lighting Companies and Others.—J. T. WILLIAMS & SONS, Engineers and Metal Merchants, South Bermondsey Railway Station, London, S.E., are cash purchasers of Engines, Boilers, and good Electric Plant for re-fixing; also old obsolete Dynamos, Accumulators, Cable, Scrap Iron and Loose Metals, &c. Prompt attention. National Telephone 834 Hop. 6476

ACCUMULATORS, Second-hand, any type, wanted; also Dynamos and Machinery, Lead Peroxide, Old Copper Cable, Scrap Metals, and every description of Metallic Dross purchased for cash, town or country.—Write A. BROWN & SONS, 142, Lower Clapton Road, N.E. Telephone: 1355 North. Late of 77, Lansdowne Road, Dalston. 9121

(Continued on next page.)

ARTICLES WANTED.—*Continued.*

MOTOR-Generator, about ½-H.P., or under. Motor 240-volt continuous; Dynamo low voltage, shunt wound. Suitable for charging ignition cells; good order and cheap.—26, Nutford Place, London, W. 1106

OLD Electric Lamp Ends, Cable and Wire bought for cash.—SMITH & Co., 2, Ranelagh Road, East Ham, London, E. 2818

OLD Electric Cable, Dynamos, Machinery, Accumulators, Scrap Metals, or any Electrical Machinery purchased for cash in town or country.—Apply to I. LEVY & SONS, 62, Albany Road, Old Kent Road, S.E. Telegraphic Address: "Levisomnus, London." Telephone No. 1747 Hop. 9697

PATENTED Successful Engineering Specialties wanted by firm of Electrical and Mechanical Engineers, either for manufacturing or representing same in Austria-Hungary. Communications with full particulars, address 1095, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

PLATINUM, in any form and quantity, purchased at highest prices by DERBY & Co., LTD., 44, Clerkenwell Road, London. 6522

WANTED.—Electric Lamp Tops and Scrap Platinum.—EDEY AND Co., 29, Ludgate Hill, London. 168

WHY keep obsolete Plant? Scrap it! Write us for offers.—DONALD MCCALL, 27, Greenwich Road, S.E. 1091

PREMISES & SITES TO LET OR WANTED AND FOR SALE.

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TO Electricians, Engineers or Motor Manufacturers.—Extensive manufacturing premises to let, 2600 ft. floor space, good light, two floors, with front shop in main road, Wimbledon. Rent £60, or remainder of lease (15 years) would be sold.—Apply PERCY A. WYNN, 12, Merton Road, Wimbledon. 1040

WAREHOUSE or Storage (off Holborn).—New building, L.C.C. requirements. Ground floor (dry), 864 ft. super. Rent only £65 p.a. Theobald's Road, 3750 ft. super.; about £150 p.a. — PARKINSON'S, 13-17, Fisher Street, Southampton Row (Holborn end). 839

MISCELLANEOUS.

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DRAWINGS.—Any description of drawing undertaken by experienced draughtsman.—TURNER, "Melrose," Burlington Road, New Malden. 1002

MISCELLANEOUS.—*Continued.*

ENGINEERING Mathematics, Correspondence Course.—Subjects include Algebra, Trigonometry, Mensuration, Logarithms, Graphical Algebra, and Squared Paper Work, Evaluation of Formulæ, &c. Students taken for the Calculus.—Particulars from the Correspondence School of Engineering Mathematics, Bilston, Staffs. 1147

EPSTEIN Accumulator Plates for Storage Batteries are now supplied by the sole licensees and makers, W. O. ROOPER AND Co., Electrical Engineers, Stafford. 80

MANUFACTURERS of Electrical and Mechanical Engineering goods who can guarantee good deliveries and desire to extend their sale in Lancashire, Yorkshire and Cheshire are requested to communicate with 1078, ELECTRICAL REVIEW 4, Ludgate Hill, London.

NOW Ready!—The *Practical Engineer* Electrical Pocket Book and Diary for 1907. Revised and enlarged. Price, cloth 1s.; leather gilt with pocket and elastic band, 1s. 6d. net, postage 2d.— THE TECHNICAL PUBLISHING Co., LTD., 287, Deansgate, Manchester, 55, Chancery Lane, London, W.C., and all Booksellers 1125

SEARCHLIGHTS for Sale or Hire.—JOHNSON & PHILLIPS, Victoria Works, Charlton, Kent. 3945

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CONVEYING PLANT.

Telegrams "Accouple, Leeds."
Telephone: No 1982 "Leeds."

MAKERS:

Graham, Morton & Co

Works: Hunslet,

LEEDS,

ENG.

John E. Raworth,

Queen Anne's Chambers, The Broadway, Westminster, S.W. Patent Agent.

C. PASS & SON, Ltd.,

BEDMINSTER SMELTING WORKS, BRISTOL.

Sellers of ANTIMONIAL LEAD of all Grades.

BUYERS OF

LEAD ASHES and LEAD RESIDUES from ACCUMULATORS.

Telegrams: "PASS, BRISTOL." Telephone 478.

. . THE . .

ELECTRIC TRAMCAR HAND-BOOK,

For MOTORMEN, INSPECTORS and DEPOT WORKERS.

By W. A. 2/6 AGNEW.

POST FREE *2s. 8d.*

H. ALABASTER, GATEHOUSE & CO.,

4, LUDGATE HILL, LONDON, E.C.

J. PITKIN & CO.

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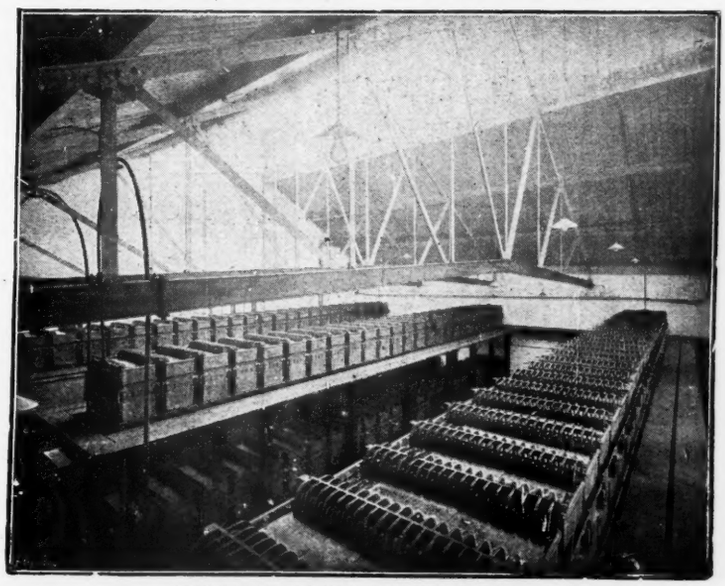

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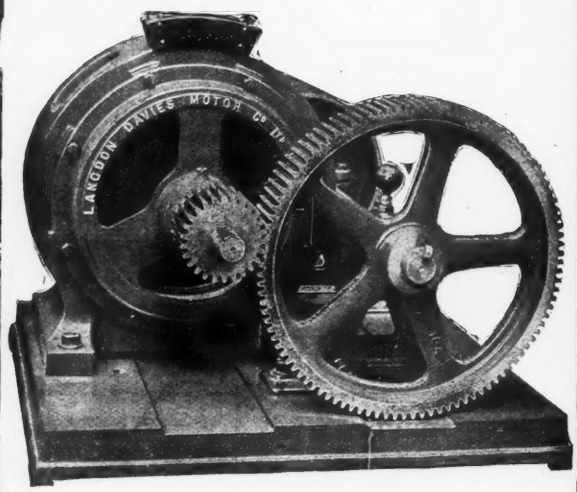

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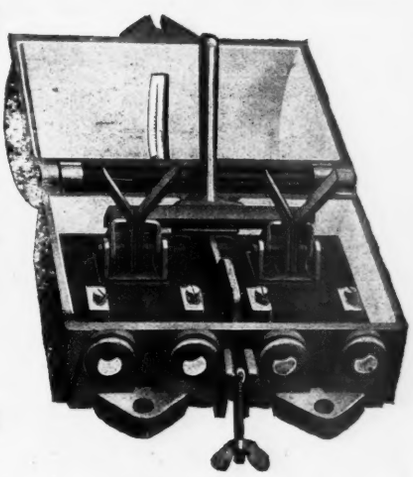

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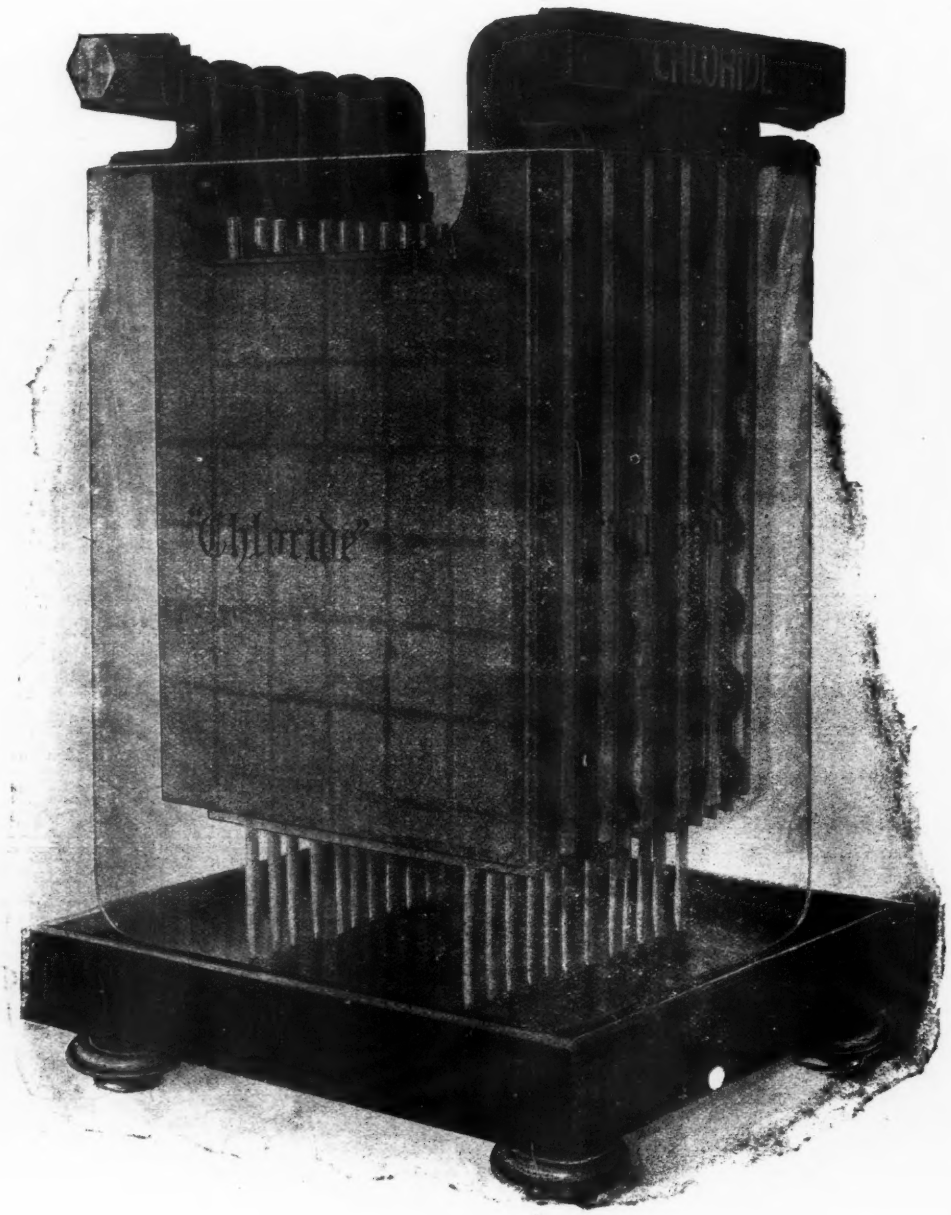

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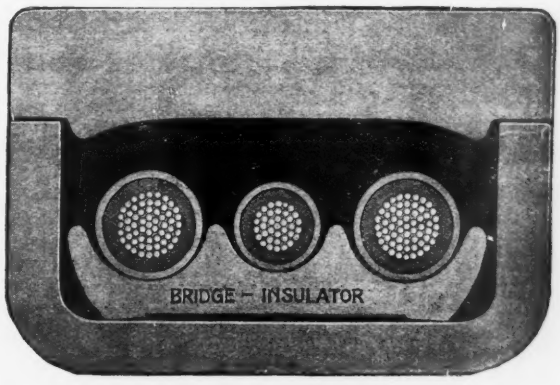

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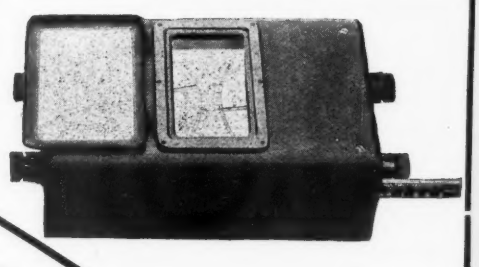

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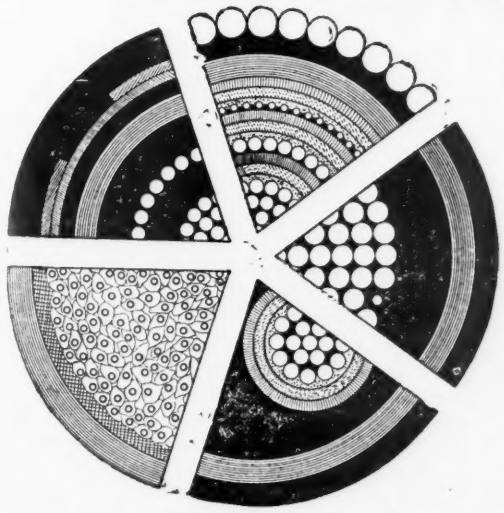

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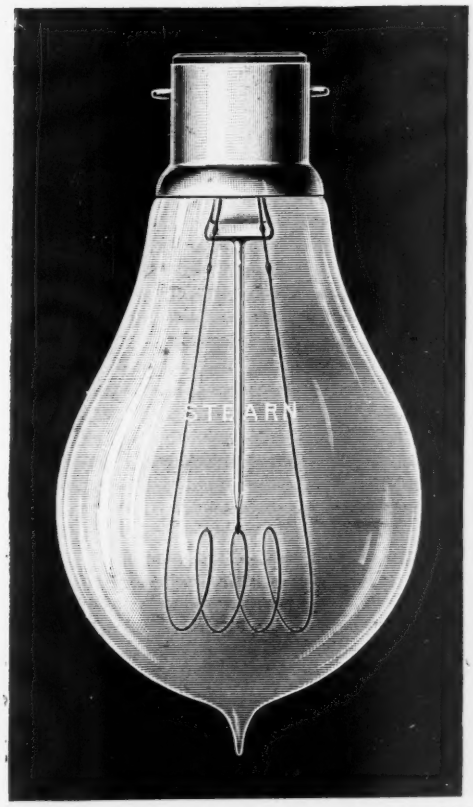

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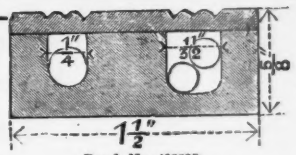

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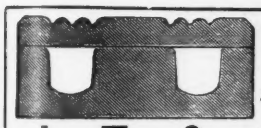

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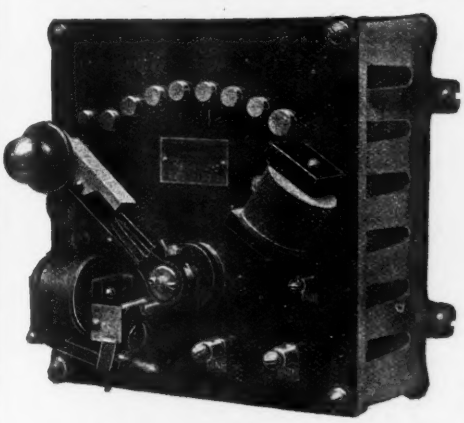

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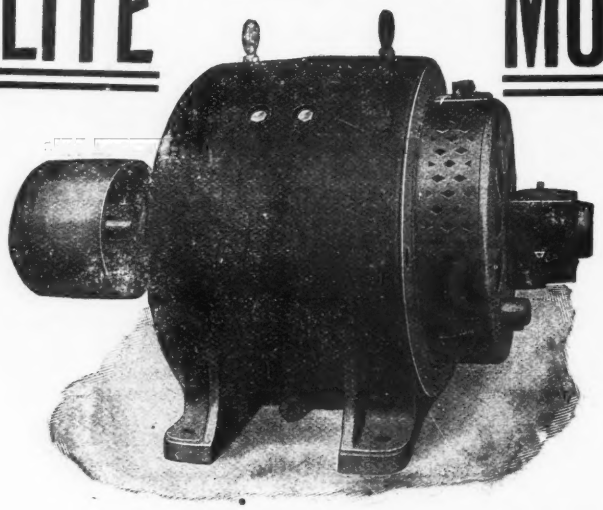

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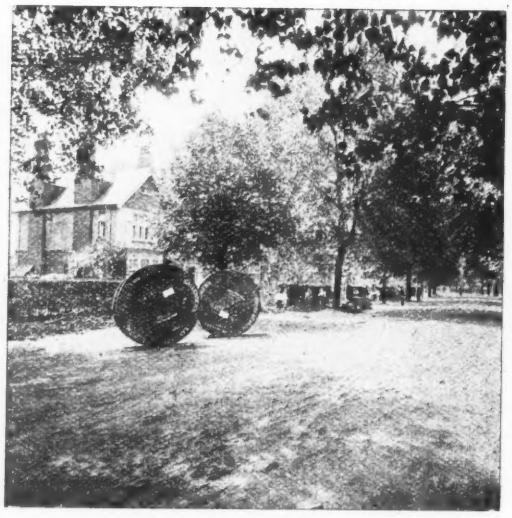

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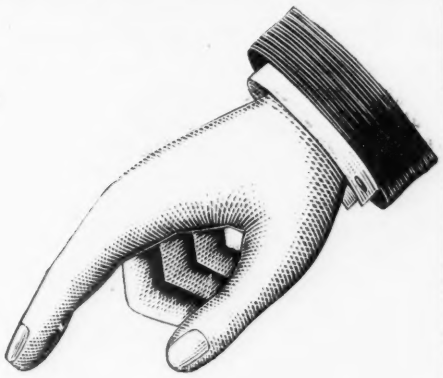

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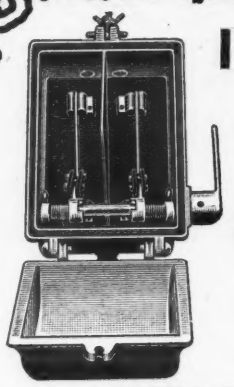

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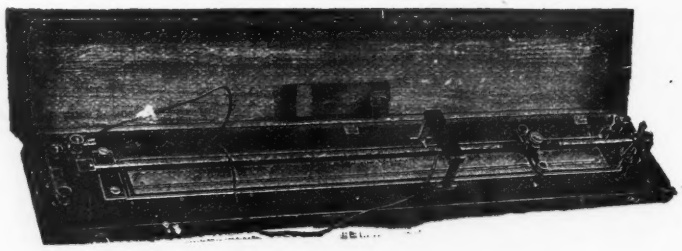

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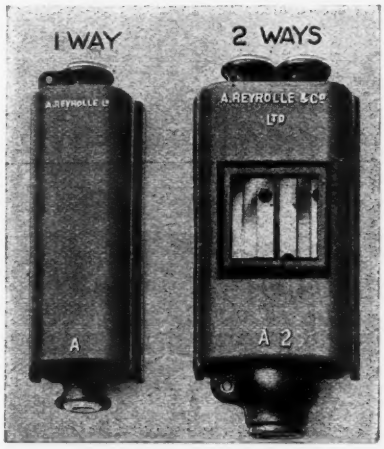

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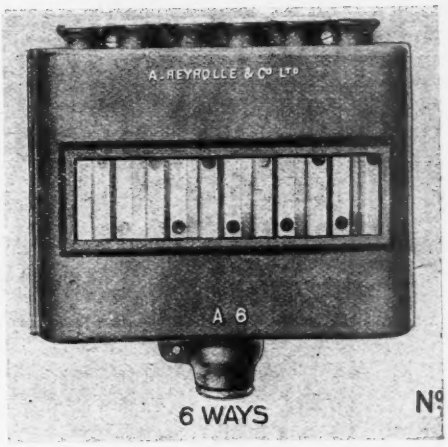

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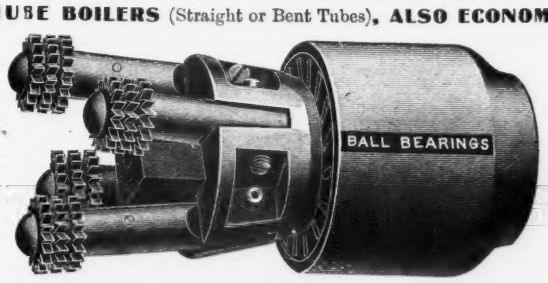

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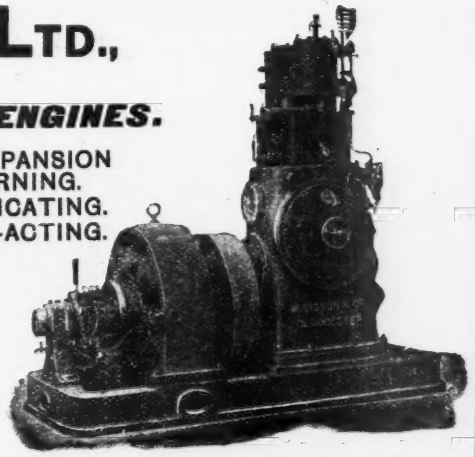

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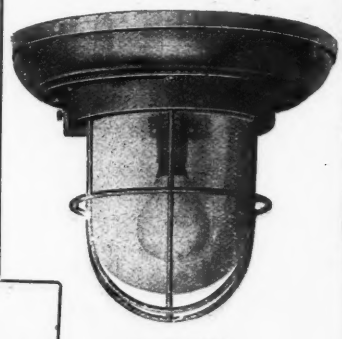

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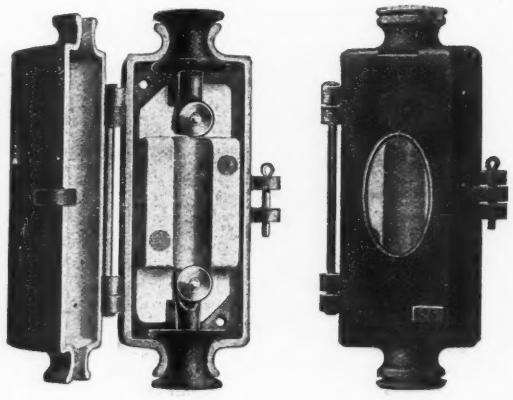

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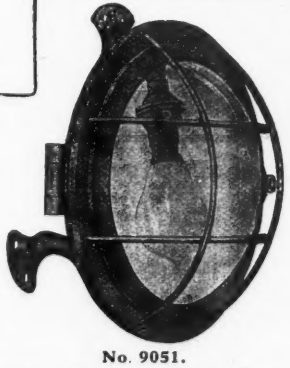

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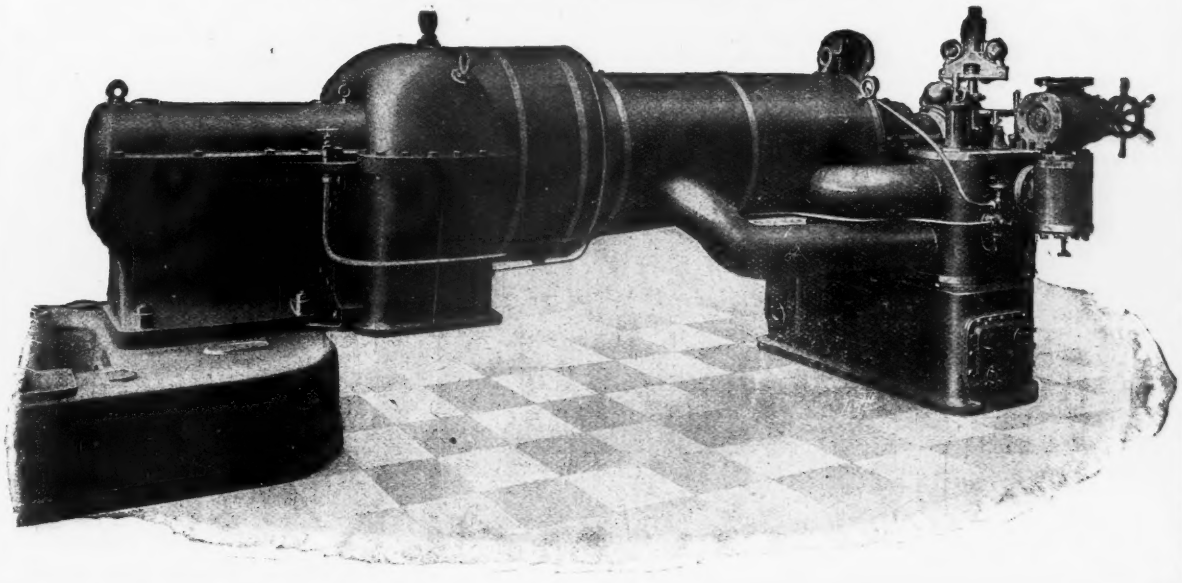

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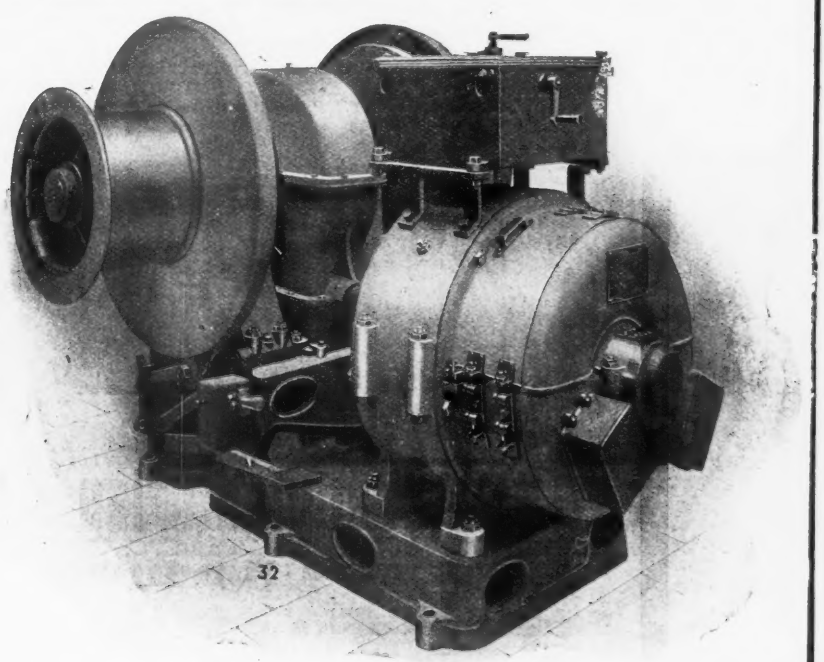

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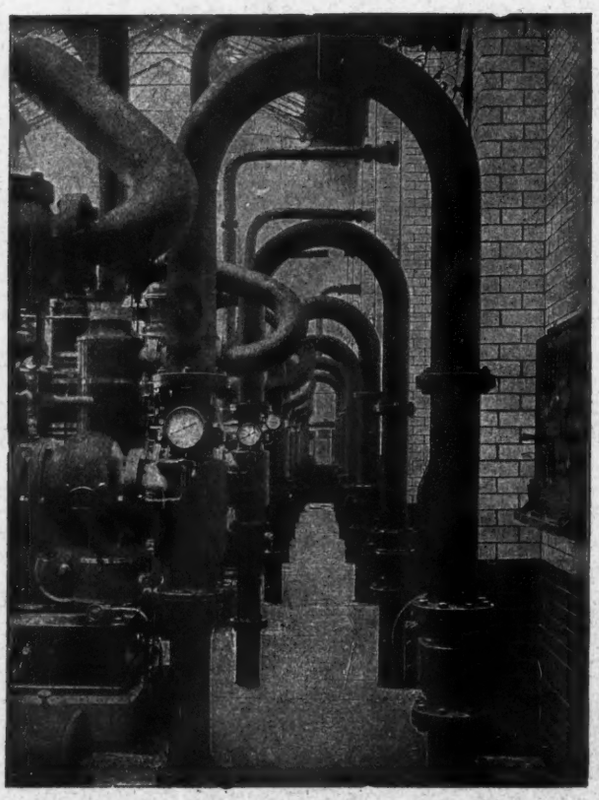

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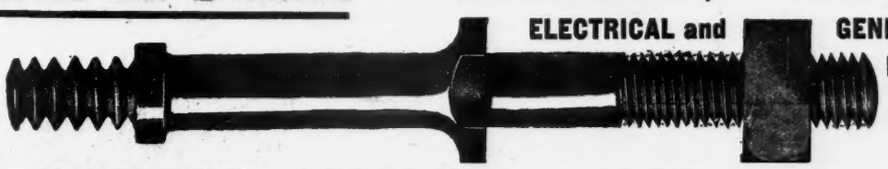

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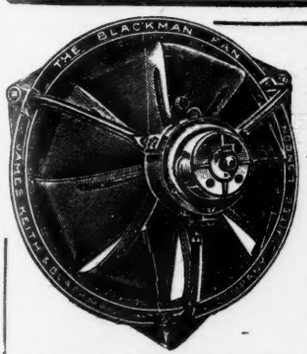

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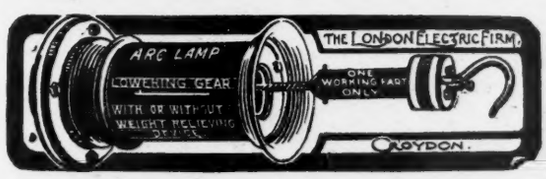

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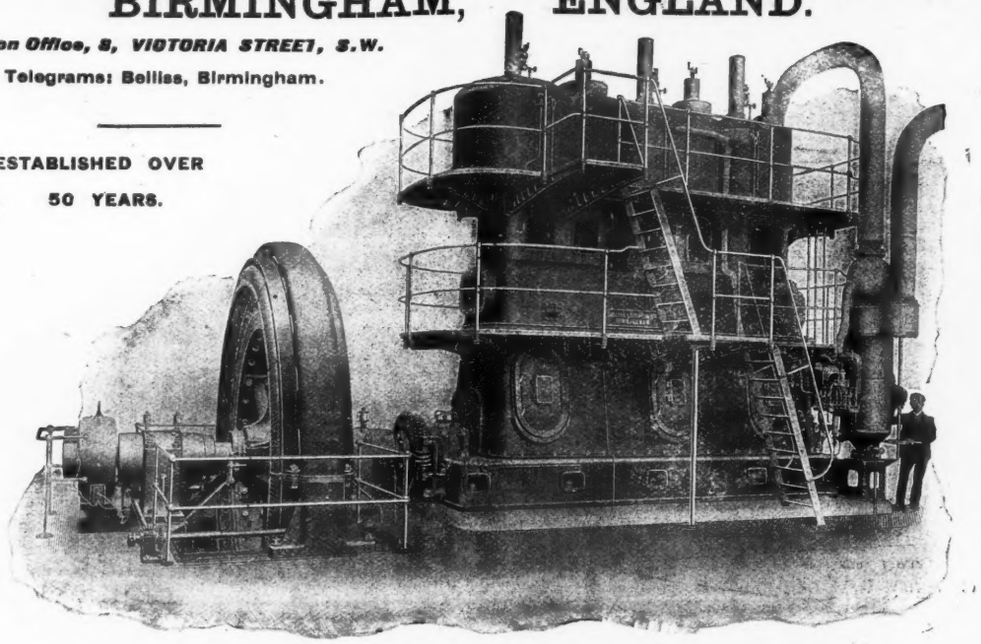

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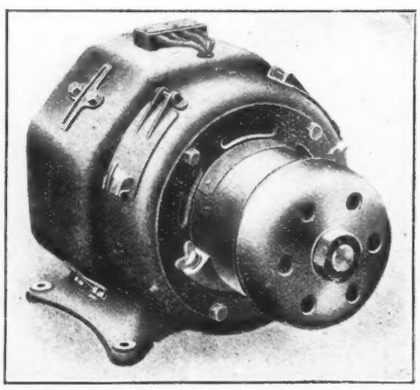

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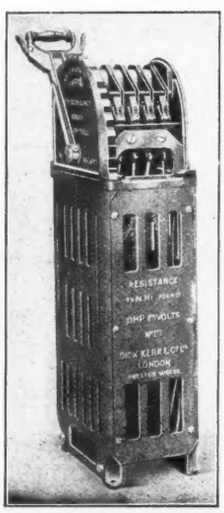

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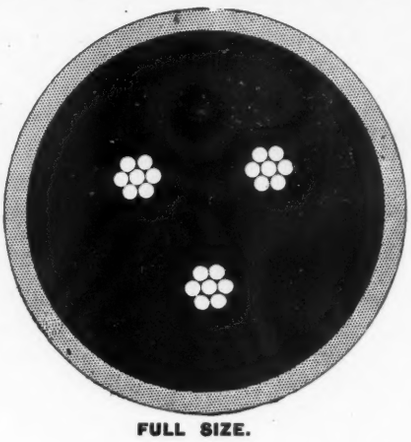

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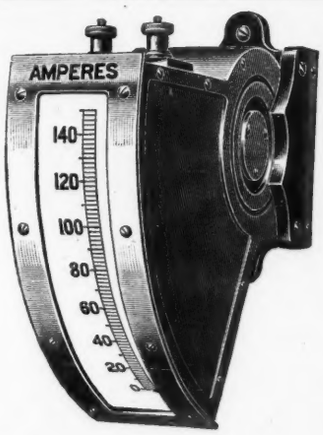

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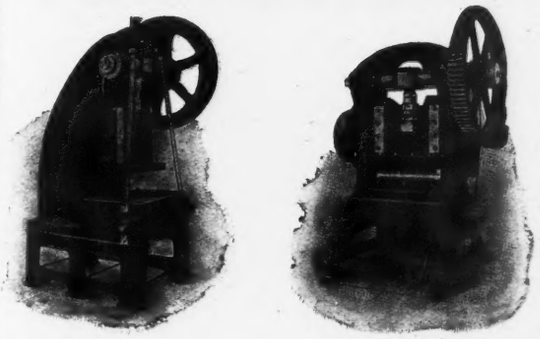

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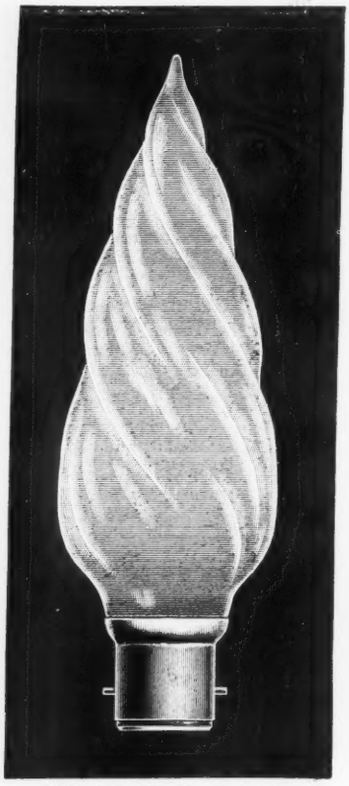

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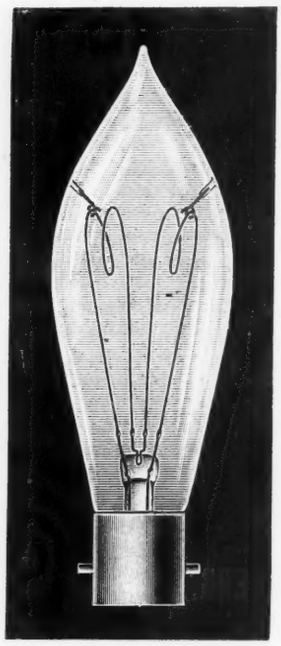

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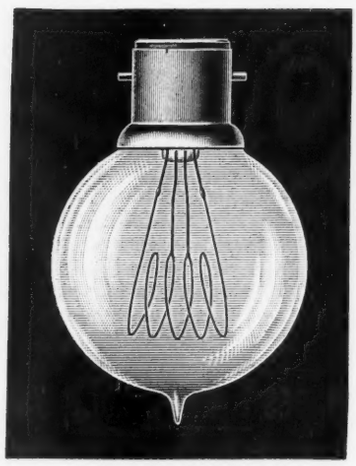

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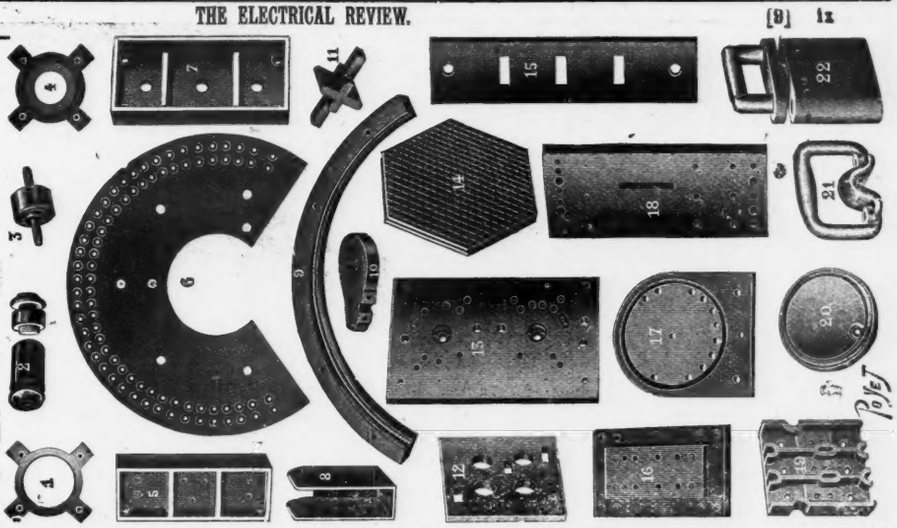

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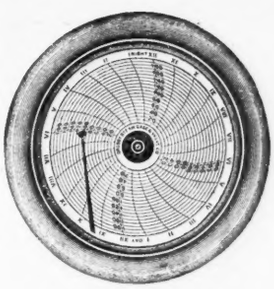

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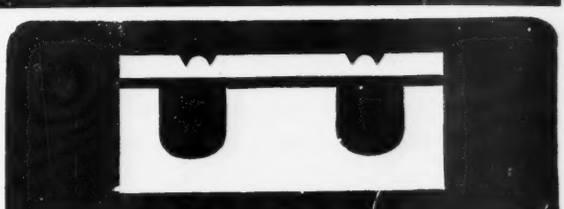

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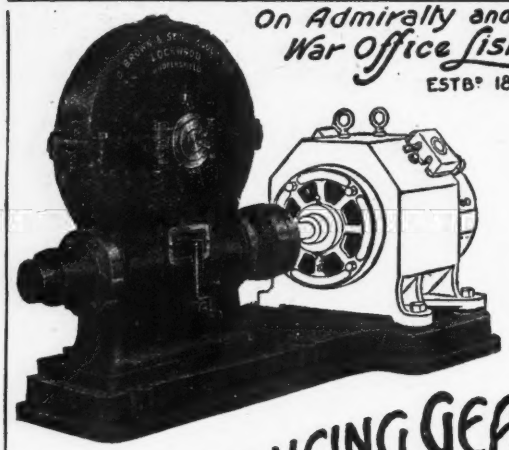

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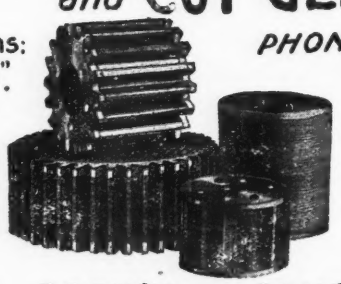

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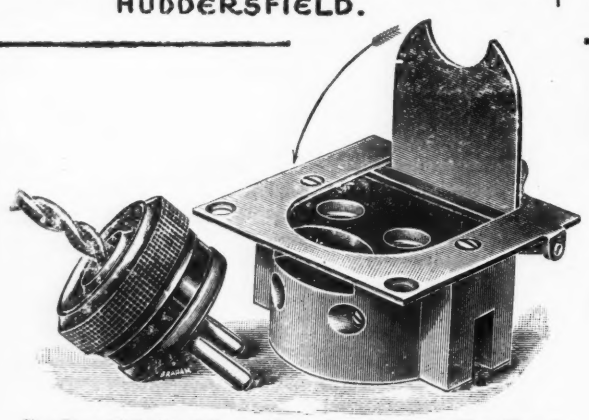

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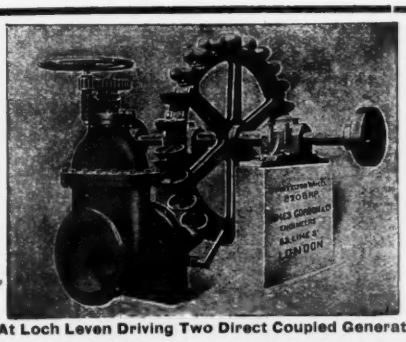

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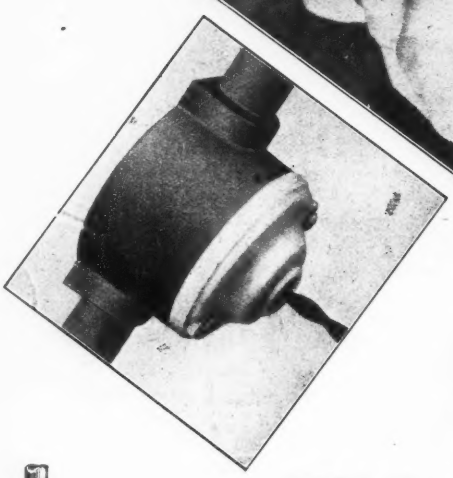

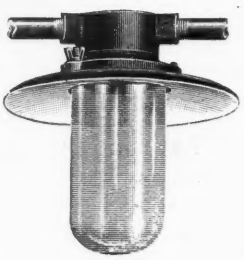

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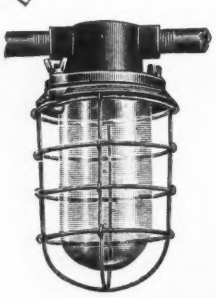

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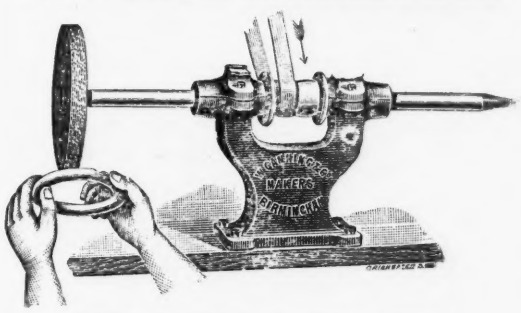

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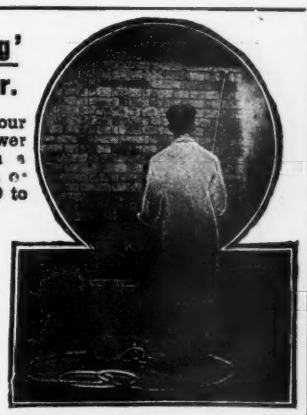

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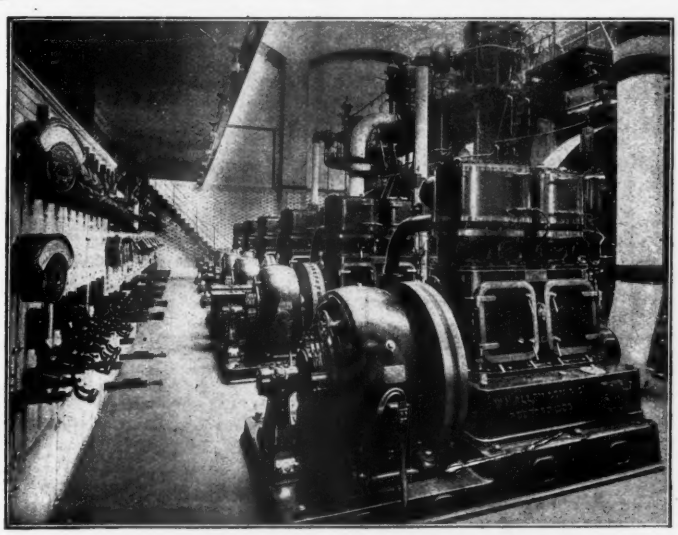

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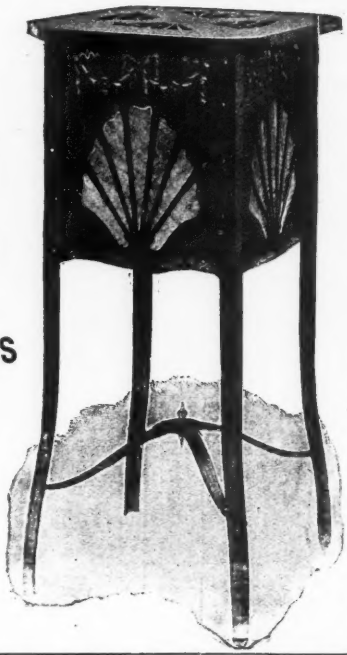

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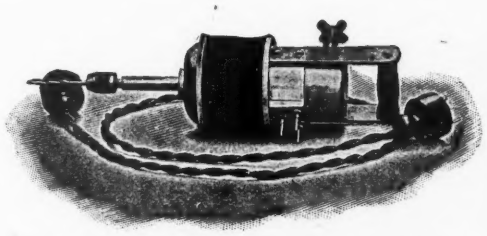

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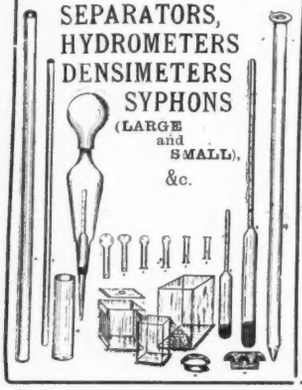

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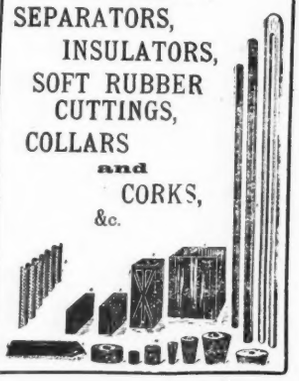

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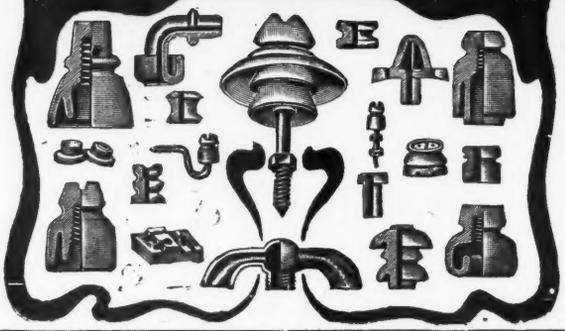

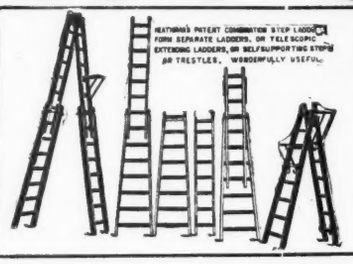

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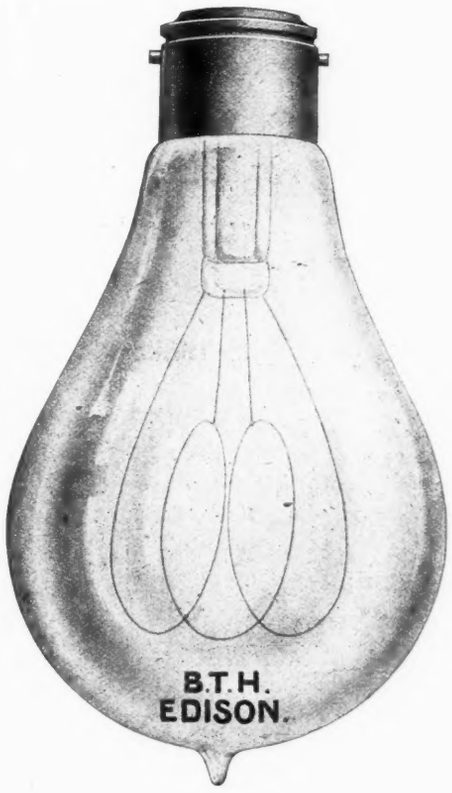

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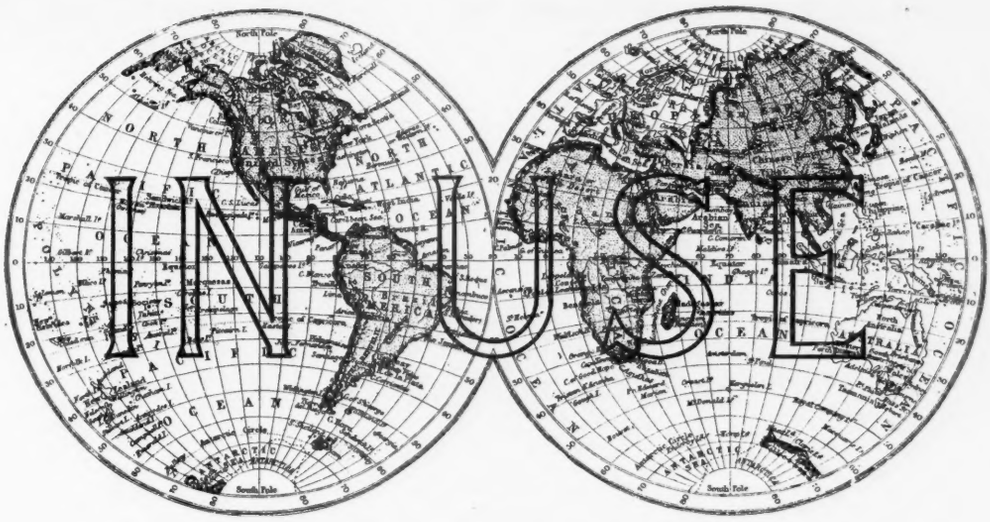

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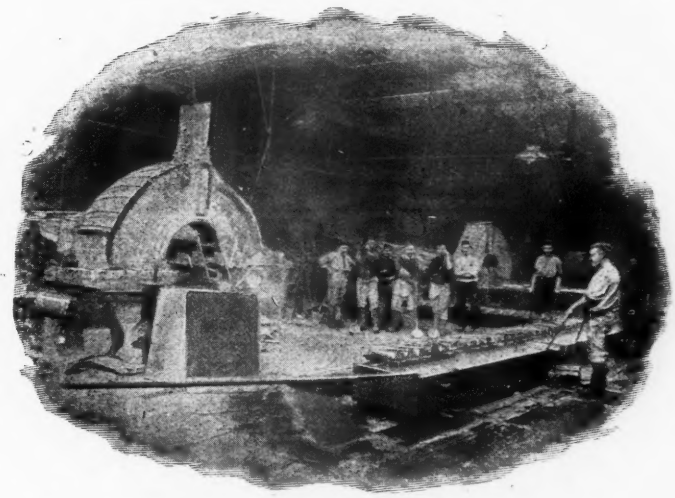

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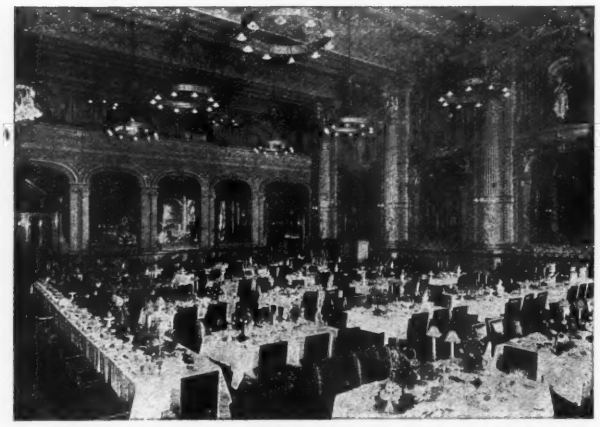

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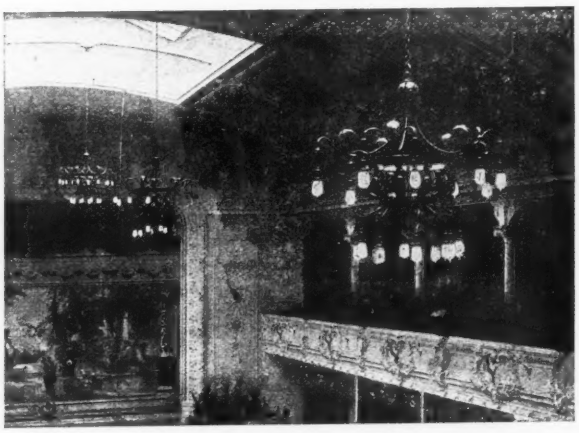

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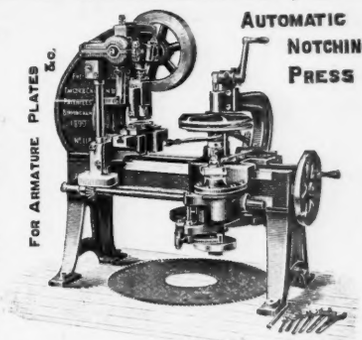

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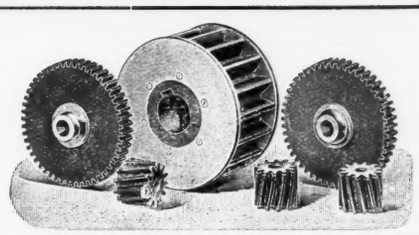

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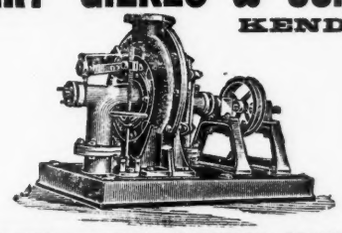

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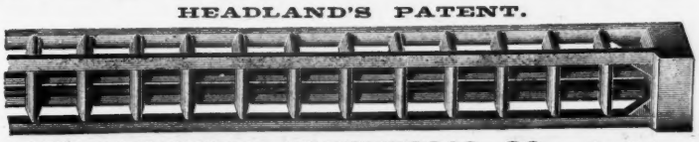

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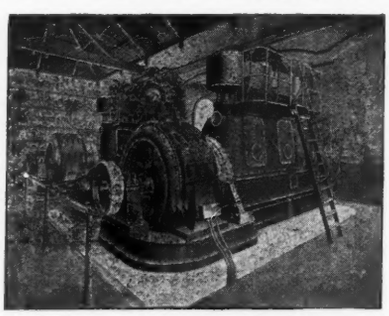

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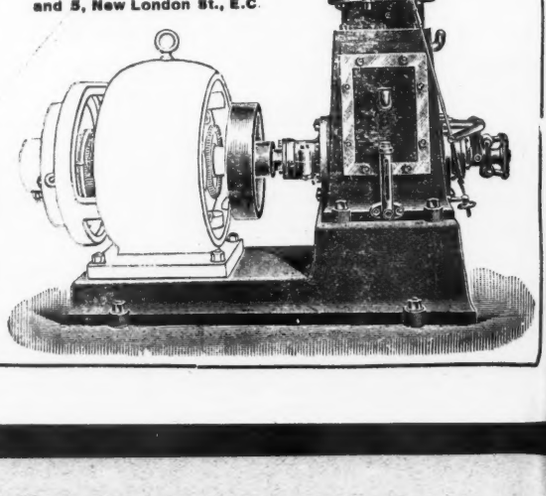

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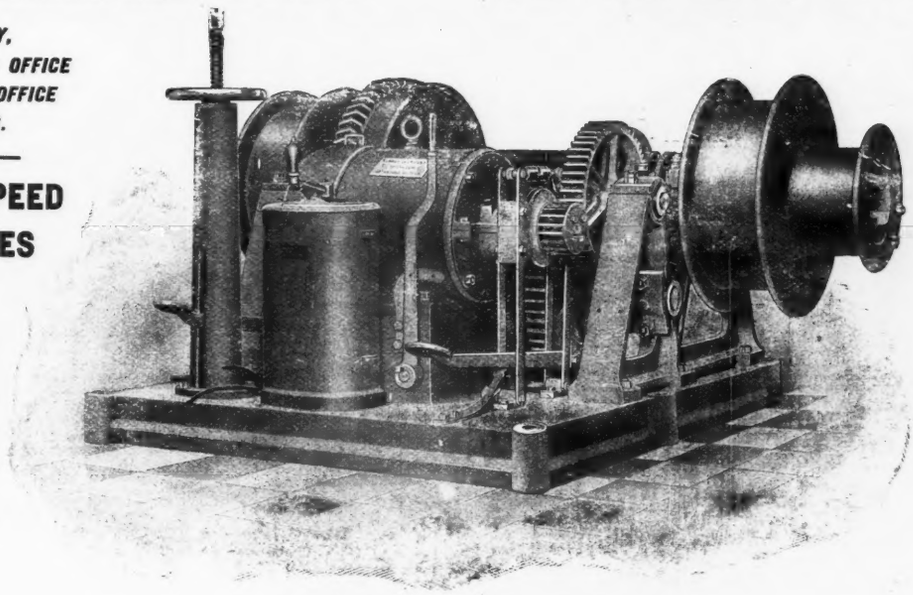

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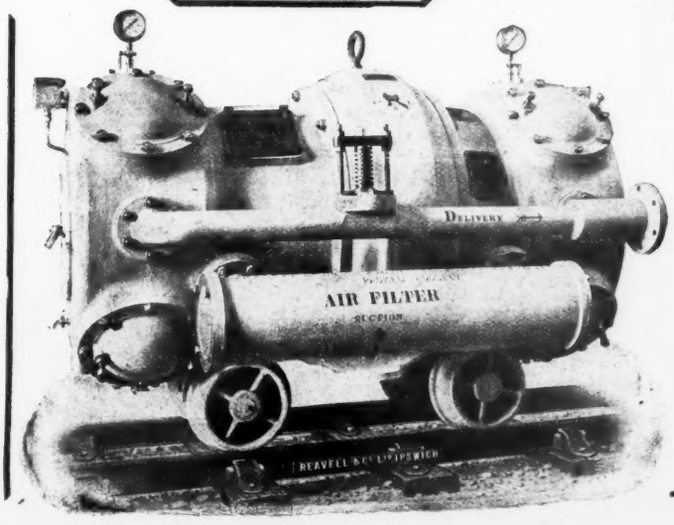

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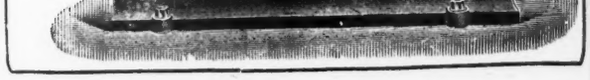

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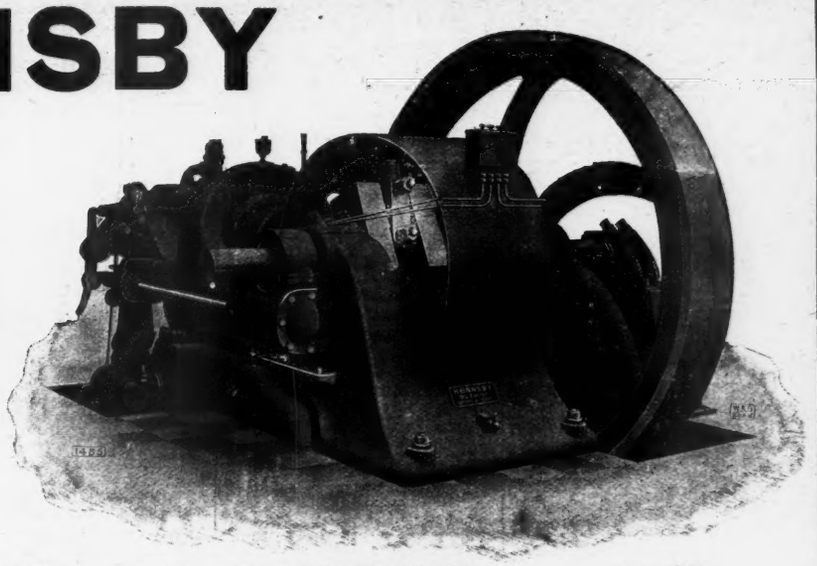

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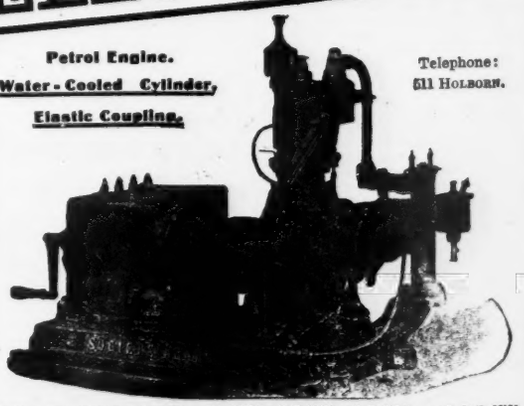

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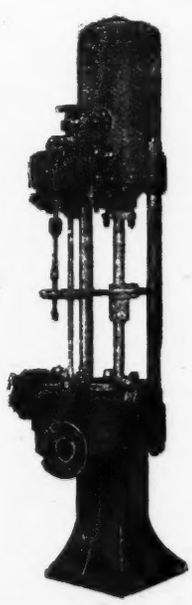

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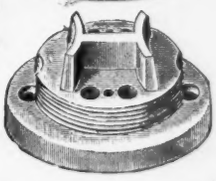

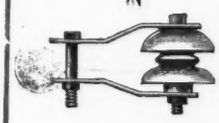

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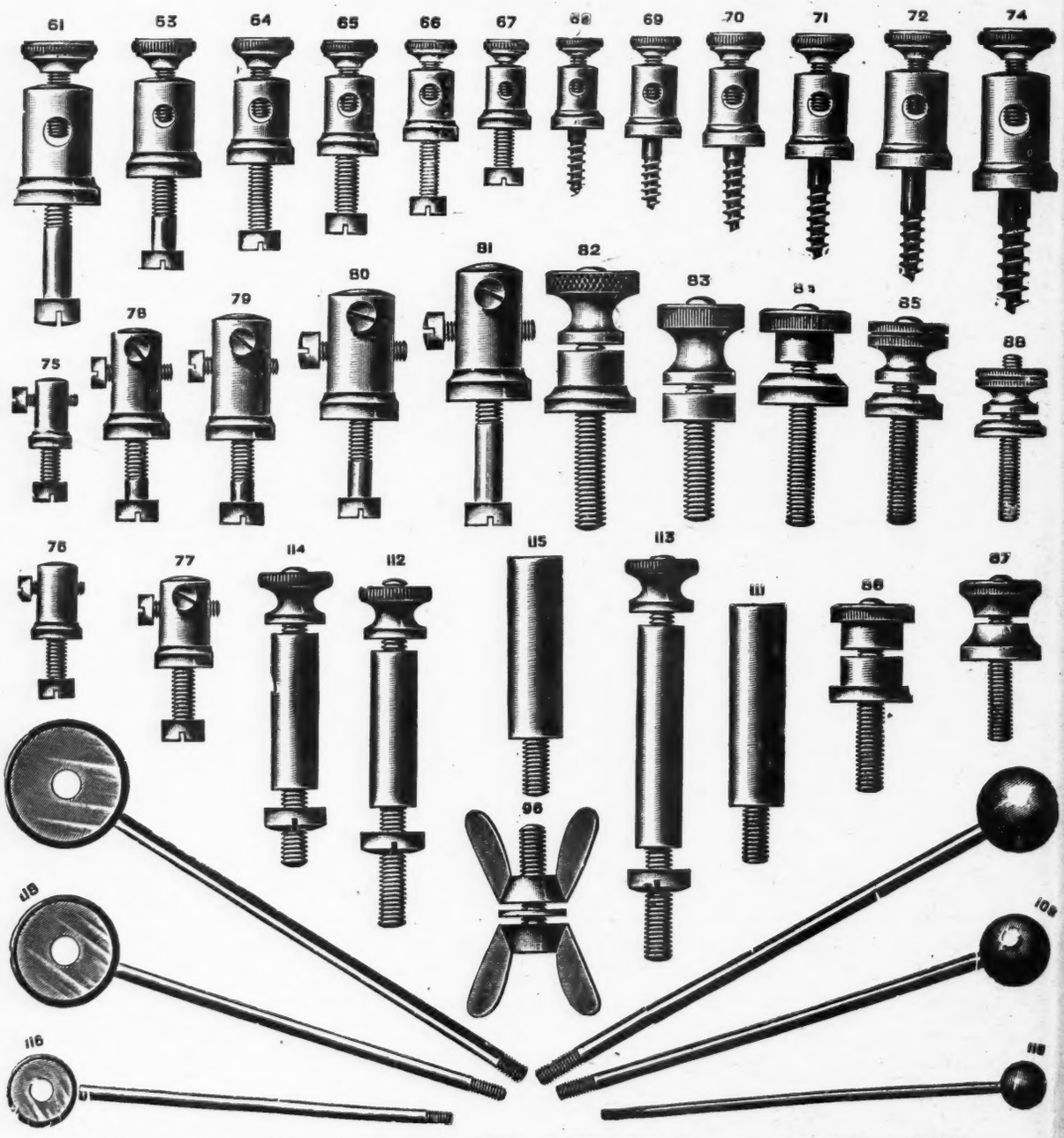

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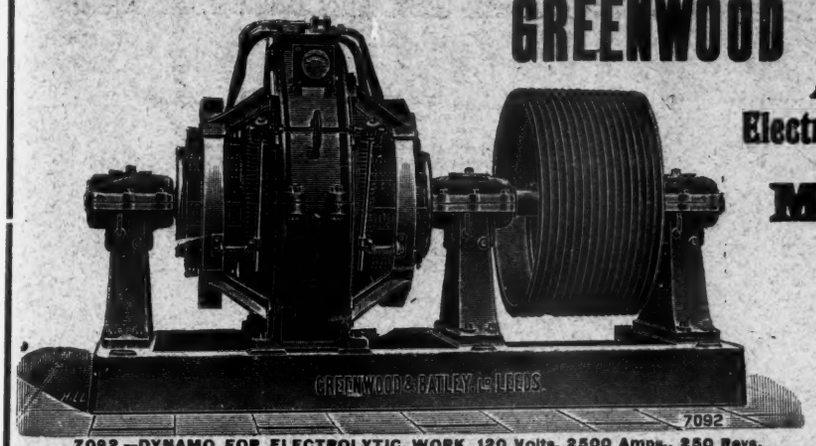

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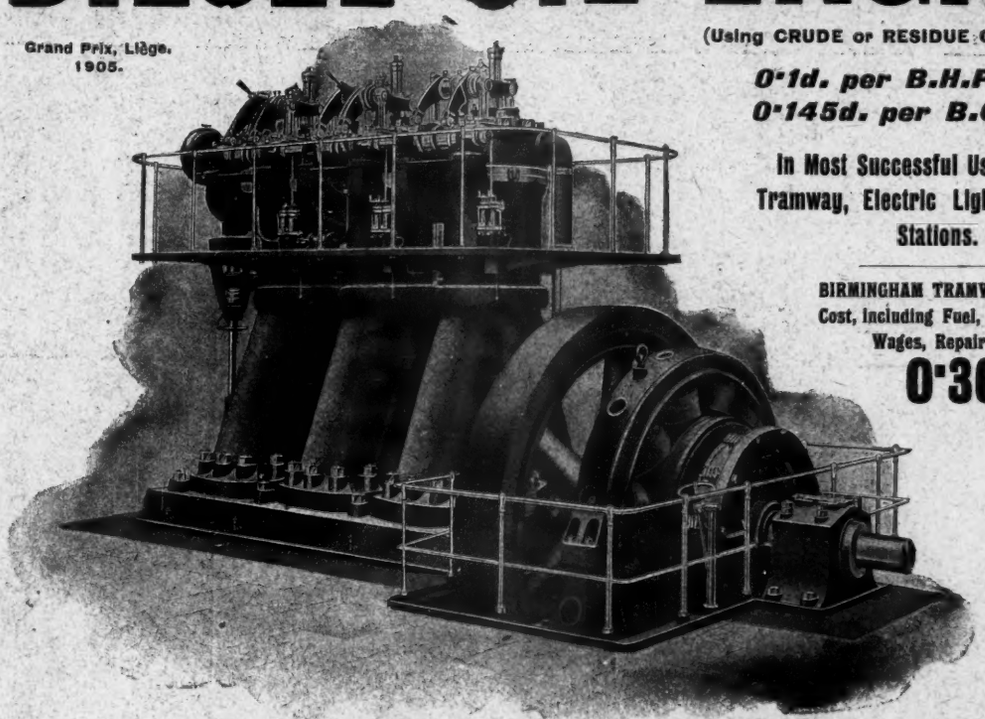

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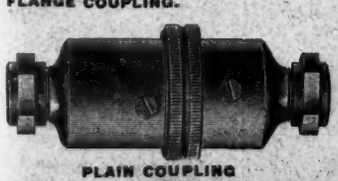

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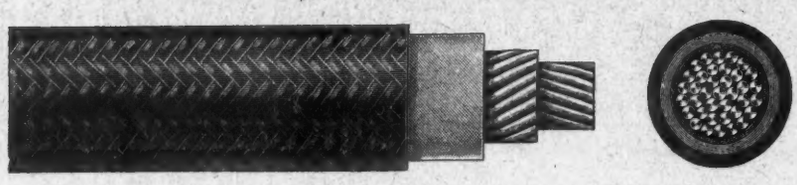

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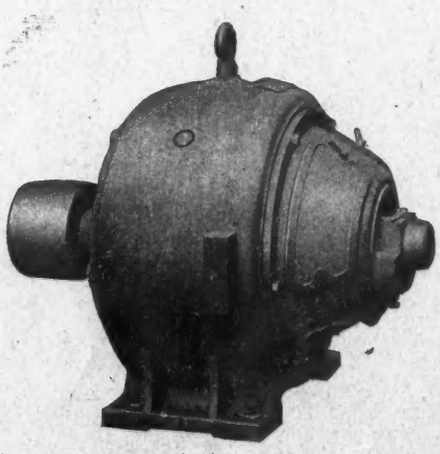

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